ETHNOGRAPHIC SURVEY OF AFRICA
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EAST CENTRAL AFRICA
PART VIII

THE SOUTHERN NILO-HAMITES

BY

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ACKNOWLEDGMENTS

16 The sources from which a survey of the Nilo-Hamites of Kenya and Tanganyika Territory can be compiled go back, with a few exceptions, to the beginning of the present century. To the 19th century, however, belong a few notable works like those of the missionaries Krapf (1860) and Erhardt (1857), and the travellers Fischer (1885), Thomson (1885), Harry Johnston (1886), and von Höhnel (1892). The first detailed tribal monographs came early in this century, beginning with those of Hollis on the Masai (1905) and the Nandi (1909), followed by Merker on the Masai (1910), Beech on the Suk (1911), [illegible] on the [illegible] ([illegible]), and Peristiany on the Kipsigis (1939). A large number of papers and a few books published up to 1950 have added to our knowledge, if not always in as much detail as one would have wished. These have been freely drawn upon, and our thanks are due to all of them.

We are happy to acknowledge help received in the preparation of this volume. For the Barabaig, on whom there is no published literature at all (except a few merely linguistic notes which are outside the scope of this Survey), I am greatly indebted to Mr. Gordon M. Wilson, who generously and painstakingly provided me with advance material from his recently completed field work. I have also had the advantage of discussing the Masai with Mr. H. A. Fosbrooke, Senior Government Sociologist, Tanganyika, who was good enough to put his knowledge of the Masai at my disposal; I have also to acknowledge his generosity both in allowing me to make use of his unpublished "Sociological Notes on the [illegible] of Masai District," and for reading my summaries of the Masai and Arusha. To Mr. Wilfred Whiteley, lately Government Anthropologist, Tanganyika, I am glad to acknowledge the benefit I have derived from discussing with him the Iraqw and Masai; and I have to thank him for several details of Iraqw organization. Lastly, I have to thank John Tompo Ole Mpaai for the willing help he has given me in the course of many talks about the ethnography and language of his people, the Masai.

In preparing the section on the Masai I have made use of a summary prepared by Miss E. [illegible], by whose industry I was much helped, especially with regard to the material contained in Merker's *Die Masai*; and I here acknowledge the use made of her work. I am also grateful to Miss Barbara Pym, of the International African Institute, for patiently answering the many queries which I put to her. I have discussed questions of orthography, in particular that of Masai, with Professor A. N. Tucker, but I have not in every case, for reference purposes, adhered to the spelling as used in the *Handbook of African Languages*.

G. W. B. Huntingford.

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THE SOUTHERN NILO-HAMITES[1]

INTRODUCTION

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The Nilo-Hamitic peoples included in this volume form, in the main, two reasonably compact related groups: the Nandi, who live on the western edge of the Kenya highlands; and to the east of them, the Masai, whose land formerly stretched north and south for 400 miles along the Great Rift Valley. The Nandi-speaking tribes, homogeneous in culture, are derived from a common stock; and their culture has in turn a good deal in common with that of the Masai. Distributed through the highlands occupied by the Nandi and Masai are the scattered hunters[2] of Okiek, more commonly known as Dorobo or Wandorobo, the forest-dwelling hunters who preceded the present native inhabitants of Kenya Colony and northern Tanganyika Territory. The racial position of these Dorobo is uncertain: some people regard them (I believe erroneously) as early Nilo-Hamites; but since they have derived their present language and much of their culture from the Nandi, they are entitled to a place among the Nilo-Hamites.

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The Tatog division of the Nandi group is separated from the rest of the Nandi-speakers, and lies close to the edge of the southern Masai; these people are included with the Nilo-Hamites on the score of language alone, since at present there seems to be no evidence of physical or cultural connection between them and the rest of the Nandi group. The languages, however, are unmistakably related, and therefore justify their inclusion here.

The third group, described as "unclassified," has been included because the peoples embraced by it live on the fringe of the Nilo-Hamites and would otherwise have been left out of the Ethnographic Survey altogether, since they cannot be fitted into any East African group under any existing scheme of classification. For these reasons it is considered that their appearance here is justifiable. The Iraqw and their congeners are sometimes described as Hamitic; but this attribution is by no means certain, nor has it yet been possible to classify their languages in spite of the availability of material, and for the present they must be left as "unclassified." The Hadzapi are "bushmen"—wild hunting people of the bush; and the Sandawe seem to be analogous to the Hottentots. These have a number of links with the Bushmen and Hottentots of South-West Africa; but they belong territorially to East Africa.

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The majority of the Southern Nilo-Hamites are pastoralists practising (with the exception of the Pastoral Masai) a little agriculture, intensely conservative, devoted to their cattle, and regarding the rest of the world with contempt, a condition from which even now many of them are but slowly emerging. These characteristics help to explain such things as the absence of any extensive development of trade, and the lack of headway made among many of them by missionary efforts. In pre-European days they not only lay outside the slave trade, but largely controlled the ordinary coast trade to the highlands; hence Islam did not appear among them.

NOMENCLATURE

1. Nandi Group

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There is no general term which is used by the people themselves to cover the main Nandi-speaking group, but (1) all Dorobo call themselves Okiek, sing. Okiot, though they have no tribe-names of their own; (2) the term Tatog(a) is a group name covering eight tribes of which the Barabaig are the largest.

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[1] For the relationship of the Southern Nilo-Hamites to the other Nilo-Hamitic Peoples, see *Ethnographic Survey, East Central Africa*, Part VI.

[2] The reasons for choosing this term "hunter" are given in my paper "The social institutions of the Dorobo," *Anthropos*, 1951, XLVI, p. 2.

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The Suk division of the Nandi group comprises the following tribes:

101 1. Pokwut or Pokot, sing. Pocon or Pocon, commonly known as Suk, which is the Masai name for them (I-Suk, sing. O-Suki). The Nandi call them Kimukon (Kimukonyek).[*]

2. Endo or To, called Cepting by the Suk.

3. Marakwet (Marakwetek), sing. Marakwetin (Marakwetindet), commonly known as Marakwet, Maragwet.

The Nandi division of the Nandi group comprises the following tribes:

1. Nandi, who formerly called themselves Cemual (Cemualek), sing. Cemualin (Cemualindet), now use Nandi (Nandiek), sing. Nandiin (Nandiindet) derived from Swahili *mnandi*, "cormorant." The Suk call them Cemusal, sing. Cemusalin; the Masai, Il-Tiepusi, sing. ol-Tiepusii.

2. Kipsikis: call themselves Kipsikis (Kipsikisiek), sing. Kipsikisin (Kipsikisindet). The Masai call them Il-Kakisan or -Kakisang, sing. ol-Kakisani or -Kakisangi. They are often referred to as "Lumbwa," owing to an early mistake which became perpetuated.[*] They are sometimes called Kipsigi, but the final s is part of the name.

3. Terik: call themselves Terik (Terikek), sing. Terikin (Terikindet). Commonly known by non-Nandi as Nyangori, Nyang'ori.

4. Keyo: call themselves Keyo (Keyek), sing. Keyin (Keyindet). The Masai call them Il-Keyio, sing. ol-Keyioni, from which is derived the form Elgeyo by which Europeans commonly know them.

5. Tuken: call themselves Tuken (Tukenek), sing. Tukenin (Tukenindet), and also Kamasya (Kamasyaek), sing. Kamasyain (Kamasyaindet), which Europeans commonly pronounce Kamasiya. Tuken is also written Tukin, Tugen, Tugin.

6. Kony: call themselves (Il-) Kony (Koneek), sing. Kopin (Kopindet); the Nandi call them Kony (Konyek), sing. Konyin (Konyindet). Europeans and others call them Elgonyi, Elgoni, and sometimes "Elgon Masai."

7. Pök: call themselves Pök (Pokek), sing. Pökin (Pokindet). A common mis-spelling is Bawgek. The Bantu call them abaLago, abaLako.

8. Sapei: call themselves Sapiiny (Sapiinek), sing. Sapiiyin (Sapiiyindet), and also Kamecak (Kamecakek), sing. Kamecakin (Kamecakindet). The Nandi call them Sapeiny (Sapeinyek), sing. Sapeinyin (Sapeinyindet). Other forms current are Sawe, Save, Savei, Sebei.

9. Sapaut: call themselves Sapaut (Sapautek), sing. Sapautin (Sapautindet). Other forms current are Sabaut and Sabaot; the latter seems to be used officially nowadays to mean the Kony and Pök.

10, 11. There are two small tribes on the Uganda side of Elgon called Mbai (Mbaiek) and Kipsorai (Kipsoraiek) or Sore (Soreek), mentioned by Hobley.[*] But nothing appears to be known of them except their names, though Hobley said the Sore were supposed to be treacherous in their dealings with caravans, and a Nandi once described them as being exceptionally timid.

The Dorobo division of the Nandi-speaking group comprises the various hordes of Dorobo scattered over the Kenya Highlands, all of which call themselves Okiek (primary Oki), sing. Okiot (primary Okio), but have no horde-names. The Nandi also call them Okiek. The Masai name for them is Il-Torrobo, sing. Ol-Torroboni, from which comes the form Dorobo and its variants like Andorobo, Eldorobo, Wandorobo, Wanderobbo, etc.

Since they have no horde-names of their own, it has been found convenient to devise names by which the hordes can be distinguished. These names, which are listed in *Anthropos*, 1951, XLVI, p. 2, are mainly geographical, and are merely labels for reference, not names used by the Dorobo. The hordes are: Western

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[*] Nandi tribe-names in brackets ( ) are the secondary forms with the definite article suffix.

[*] *Nandi Work and Culture*, p. 2.

[*] *Eastern Uganda*, p. 60.

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group: Kipkurerek, Tinderet, Lembus, Burkin, Western Mau, Eastern Mau; Central group: Dondole, Salato, Koibatek, Digiri; Eastern group: Mt. Kenya, Eldama Ravine group: [illegible]. The western, central, and eastern groups are all in Kenya, the southern in Tanganyika Territory. OFD

The Tatog division comprises:*

1. Barabaig: call themselves Barabaik, sing. Barabaiwda; the sing. primary form is Barabaiw; the plur. primary Barabe has not yet been recorded. 2. Gisamjek. 3. Daremajek. 4. Darorajek. 5. Buradik. 6. Bianjek. 7. Rotigenik. 8. Gidanoodik. T 101

The Tatog (Tatoga) are called Taturu by their Iraqw and Bantu neighbours; this is said to be a corruption of Tatog. They are called Il-Mangati, sing. Ol-Mangatiani (= "the enemies") by the Masai, and this term has crept into some of the literature.

II. Masai Group

The Masai as a whole call themselves Il-Maasai, sing. Ol-Maasani.[1] There is some uncertainty as to the nomenclature and tribal divisions of the Masai. It is clear, however, that they are not a single tribe, but a group consisting of a number of pastoral units called il-osho, sing. ol-oshon, or sub-tribes, which were associated in major units which may be called tribes and were the political units. These tribes and their sub-tribes may be provisionally set out as follows: M 101

Northern Masai:

1. Il-Aikipiak, sing. Ol-Aikipiani. Written also Laikipiya, Laikipia, and even Lykipia.

2. Il-Wuasin-kishu, sing. Ol-Wuasin-kishui. Commonly written Uasin Gishu, and formerly Guas Ngishu from the mistaken idea that it means "river (grazer) of cattle," whereas it means "striped cattle."

3. I-Sampur, sing. O-Sampurri; commonly written Samburu or Samburr. Called by the older travellers Burkeneji (i-lo-ebor-kineji = people of the white goats).

Central or Rift Valley Masai:

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4. Il-Kinopop, sing. Ol-Kinoponi, a grouping of three il-osho called Il-Purko, Il-Damat, and Il-Keek-o-nyokie. Il-Purko has been Europeanized into Ilkopure, and Kinopop into Kinangop.

5. Il-Kaputie, sing. Ol-Kaputieni, a grouping of three il-osho called Il-Kaputie, Il-oo-do-kilani, and Il-dala-le-kutuk. The first is also written Kapiti, Kapte; the second is the Doglani of the older travellers.

6. I-Loitai, a grouping of the I-Loitai and I-Siria, to which latter belong the laibons of the il-Aiser clan.

Southern Masai:

7. Il-Kisonko, sing. Ol-Kisonkoi, generally written Kisongo, the Masai of Tanganyika Territory.

All these are Pastoral Masai; the first two no longer exist as separate tribal entities: the Il-Wuasin-kishu were broken up about 1850, and lost their laibons; though they have now been re-formed under their old name, this is due to the action of the British Administration. The Il-Aikipiak have also lost their land and their separate identity. M 17/5 648

The Agricultural Masai are known as I-Lumbwa, sing. O-Lumbwani, commonly M 101

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* Information from Mr. Gordon Wilson.

[1] il and ol in Masai names and words are the plural and singular article respectively (feminine, in; sing., en). The Wuasin Kishu pronunciation is Maasae.

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12 written Lumbwa; and as Il-Oikop, sing. Ol-Oikopani, written variously Lokop, Loikob, Elkopek and even Loikop. The Kenya Masai call the pastoral Masai of Tanganyika, Kisonko, and the agricultural Masai of Tanganyika they call Il-Arusa, the people known in Tanganyika as Arusa being a strongly Masaised group of basically Pare (Bantu) origin. The name Il-Tiamus, sing. Ol-Tiamusi, written also Enjemusi, Njemusi, Njemps, etc., refers to the agricultural Masai at the south end of Lake Baringo.

The name Wakwafi, Wakuavi applied by the Swahili to the Masai does not, it seems, really distinguish agricultural from pastoral, and the distinction made by Krapf in 1860 is more apparent than real. The word is derived from the Masai in-kuapi, pl. of en-kop, "the countries," and from it come the names used of the Masai as a whole by (a) the Bantu, e.g., Kikuyu, Kamba, A-Kabi; (b) the Nandi group: Dorobo, Ipumpek; Kony, Ipumpek; Keyo, Kipumpek; Nandi, Ipumpek.

III. Unclassified Peoples

FN8 1. Hadzapi: call themselves Hadzapi, sing. Hadza. They are called Watindiga by the Isanzu, and Wakindiga and Kangeju by others.

2. Sandawe: call themselves Sandawe, sing. Sandawe'a.

3. Iraqw: call themselves Iraqw, sing. Iraqwto. Other forms used by Europeans are Irak, Iraku, Erokh. They are also called Wambulu, which is thought to be derived from the Swahili mbulu, "a person who says meaningless things because of madness or weak intellect"; and the district is known as Mbulu.

4. Gorowa: call themselves Gorowa. Also known as Goroa, and sometimes as Fiome, Fiomi, from Mount Ufiome (Ufiome).

5. Alawa: call themselves Alawa; also known as Wasi.

6. Burungi: call themselves Burungi.

GROUPING

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12 Most of the Southern Nilo-Hamites live in the highlands of Kenya Colony; the southern Masai (Kisonko) and Tatoga are found in the northern part of Tanganyika Territory.

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133 The Nandi group (Group I) is found in two concentrations: (i) to the north-east of Lake Victoria; (ii) south of Lake Eyasi.* The Dorobo are scattered over the forested parts of the highland area. The Nandi division of the group is mainly west of the Rift Valley on all sides of the Uasin Gishu plateau, at the north-west corner of which is Mount Elgon, on whose lower slopes live the Kony and Pok in Kenya, and the Sapei and Sapiñ in Uganda. East of Elgon, and at the north-east corner of the plateau, are the Suk, living partly in the hill country north-east of Kitale, and partly in the low country farther east. South of the Suk, on the western edge of the Rift Valley, and along the east side of the plateau are the Marakwet, Endo, and Keyo; east of the Keyo are the Tuken or Kamasya. The Keyo country is a long, narrow strip consisting of high grassland and forest along the top of the escarpment, the precipitous slope of the escarpment itself, and the valley of the Kerio lying some 4,000 ft. below the summit of the escarpment. The south end of the Keyo country adjoins the hill country of the Mau, in the forests of which live a number of Dorobo bands, those labelled Kipkurerek, Tinderet, Sirrian, Lembus, West Mau, and East Mau. From the Mau the southern Nandi escarpment runs eastwards towards Kavirondo Gulf, almost coinciding with the equator, and above this escarpment the Nandi country stretches northwards, with the small tribe of Terik adjoining it on the south-west. South of the escarpment is the Kipsigis country. The Nandi-speaking peoples thus enclose the open grassland where the
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* There is in addition a number of scattered pockets of Tatoga between Lake Eyasi and Lake Victoria.

[illegible]

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TRIBAL TRADITIONS

[illegible]

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Masai

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CULTURAL SUMMARY

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The Nandi and Masai form a distinct culture group; but the Suk, though they [illegible] of these features, have so much affinity with the Karamojong culture that they [illegible] in the Nandi group from the cultural point of view. Certain features of these cultures are distinctive, and can best be shown in tabular form:

A.

	Karamojong Culture: [illegible] and Turkana	Suk	Masai and Nandi
Sandals: long and narrow	Yes	Yes	No
Chignons	Yes	Yes	No
Wrist and finger knives	Yes	Yes	No
Skin capes (females)	Yes	Yes	No
Lip plugs and nose discs	Yes	Yes	No
Headrest-stools	Yes	Yes	No
Circumcision (m. and f.)	No	Yes	Yes

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	Masai	Nandi	Suk
Long narrow-bladed spears	Yes	Yes	No
Large shields	Yes	Yes	No
[illegible]	Yes	Yes	No
Ostrich-feather head-dresses	Yes	Yes	No
Swords	Yes	Yes	No
Ivory arm-clamps	Yes	Yes	No
[illegible] and [illegible] marriage	Yes	Yes*	Yes

* Throughout the Nandi division of the Nandi group.

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The Masai and Nandi features are not merely similar, but often practically identical. Shields, spears, and swords, for example, are of the same shape and size, and indeed are peculiar to the Masai and Nandi, though the shapes have been imitated by some of the neighbouring Bantu, e.g., the Kikuyu and others. The ivory arm-clamp appears to be peculiar to this group, and has an early Hamitic prototype. Masai and Nandi female dress is of the same general type, and in both the women wear a great deal of coiled wire on the arms and legs. The Hill Suk, however, are predominantly of Nandi stock, and speak a language of strong Nandi type; all the Suk also practise male and female circumcision, which is not a custom of the Northern and Central Nilo-Hamites. Hut types differ in all three: Suk huts are little more than rough grass shelters, those of the Nandi being strongly built round and [illegible] structures with [illegible] thatched roofs; but the huts of the Masai have flat roofs and straight walls plastered with dung, a shape which seems to be derived from the matting hut of such Hamites as the Somali. All members of the Nandi group, including the Dorobo, remove the two middle incisor teeth of the lower jaw. (Further details on Southern Nilo-Hamitic culture are given in the Ethnographic Survey of Africa, East Central Africa, Part VI, pp. 19-20.)

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LANGUAGE

The Southern Nilo-Hamites speak two main types of language, which are closely related, Nandi and Masai. These languages exhibit the same traits as indicated under the Northern and Central Nilo-Hamitic languages, except that Nandi has no "L" and "N" in grammatical sex determination.

It now seems that the languages of the Nandi-speaking group may be divided into three separate languages: Suk, Tatog, and Nandi, which have developed from a common stock. Suk has the dialects of Endo and Marakwet, and Nandi the dialects of Kipsikis, Terik, Keyo, Tuken, Kony, Pok, and Sapei, as well as the various Dorobo dialects. Suk, Endo, and Marakwet are very close, and are mutually intelligible, as also are the Nandi and Dorobo dialects. Suk, though basically similar in structure and vocabulary to Nandi, has certain striking phonetic and grammatical differences which render the two languages mutually unintelligible unless learnt. Tatog, as exemplified by Barabaig, is unmistakably of Nandi stock, but in sound and much of its vocabulary would be utterly unintelligible to Nandi. An important

(SW)

The reference to H. Frankfort's paper "Modern survivors from Punt," in *Studies presented to F. Ll. Griffith*, 1932, pp. 445-53, is interesting on this point.

I use the expression circumcision to include both the operation properly so called on males and the operation of clitoridectomy performed on women.

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Nandi [illegible]
Tatoga [illegible]

Not comprehensive

point of difference between the languages of the Nandi group is the presence or absence of a secondary suffix or definite article, sing. -t, plur. -k, and the method of attaching it. Suk, Endo, and Marakwet do not possess the -t/-k suffix; in Tatoga it is often added direct to the stem without any connecting vowel; in Nandi there is often a connecting vowel, e.g., [illegible] "hare," in which the final -t is the secondary suffix. In Masai, on the other hand, the "article" or gender-sign is prefixed, sing. ol-, fem. en-; pl. il-, fem. in-. The dialectal differences between the speech of the various Nandi tribes are very slight, being in fact much less than occur in the Nandi dialect group, and for practical purposes Nandi is a language without dialects.

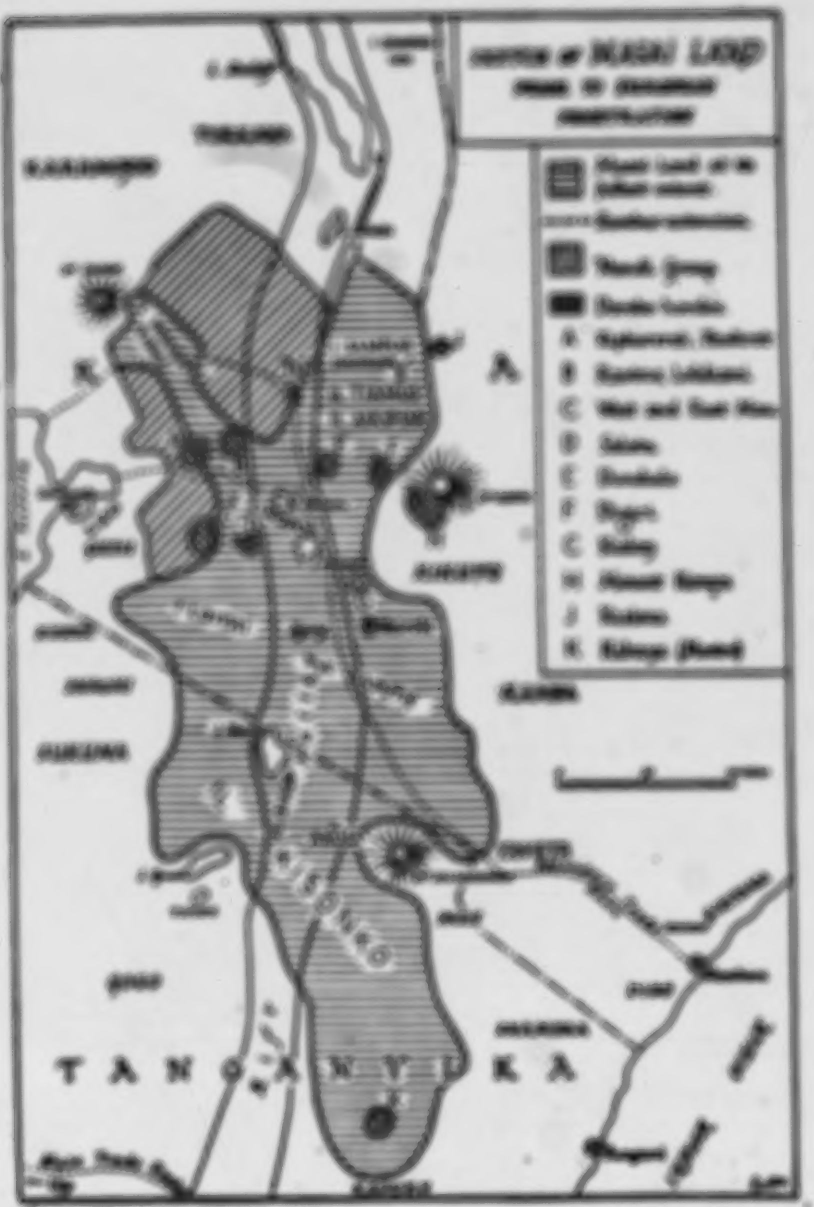
The Hadzapi speak a click language, related to one form of South African Bushman speech. The Sandawe also speak a click language, apparently related to Nama Hottentot. The Iraqw and Goroa languages are very closely related to each other, with a large common vocabulary, but it has not yet been possible to classify them. It may well be that some East African languages have survived as the speech of isolated tribes or tribal groups and will continue to defy attempts to classify them because the other languages to which they were once related have disappeared.

A poor form of Swahili, the official lingua franca of Kenya and Tanganyika, is spoken to a rather limited extent by the Nilo-Hamitic pastoral tribes, but even today many of the older and some of the younger people, especially those in remote country districts, know little of it. In 1935 less than 50% of the Nandi understood Swahili, though the percentage has since increased. Most of the Tatoga, Iraqw, and Hadzapi know very little Swahili, if any.

D. F. Bleek, "The Hadzapi or Watindega of Tanganyika Territory," *Africa*, 1931, IV, pp. 273 seq.

No further details are given on language, since this subject is dealt with in the International African Institute's *Handbook of African Languages*, to which reference should be made. It may be noted that throughout I use c to represent ch (approximately) as in "church."

[illegible] Huntingford [illegible]


A
K
TANGANYIKA

[pp. 11-101 not processed]

[illegible]

D. MASAI GROUP

THE MASAI

HISTORY

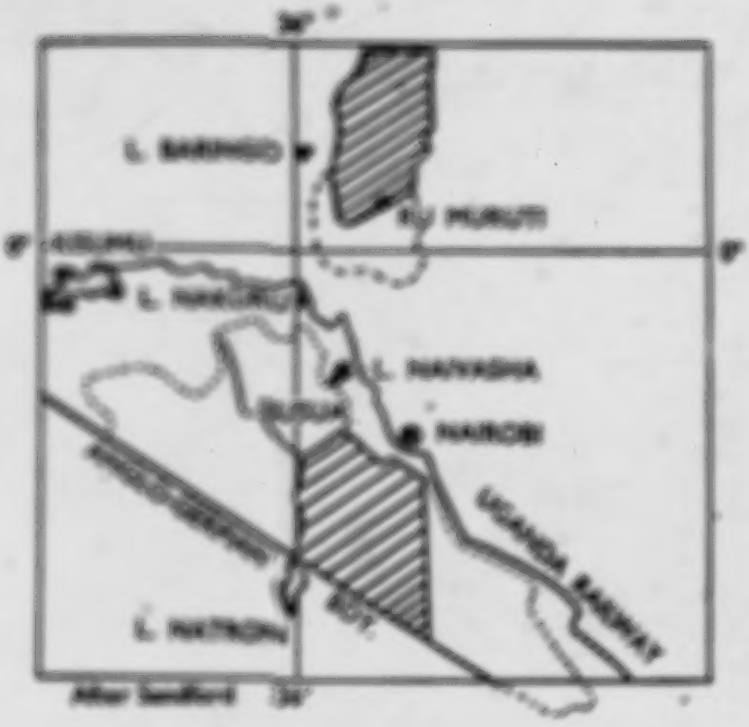
[illegible]

[illegible]

[illegible]

[illegible] Huntingford [illegible] 1953 [illegible]

THE MASAI RESERVES


36°
L. BARINGO
[illegible] MURUTI
0°
0°
L. NAIVASHA
NAIROBI
UGANDA RAILWAY
L. NATRON
36°

After Sandford

▨ Original Masai Reserves, [illegible].

[illegible]

[illegible]

DEMOGRAPHY

[illegible] Population figures for [illegible] and [illegible] were estimated as follows, the [illegible] figures including an estimated [illegible] [illegible]

	Kenya	Tanganyika		Total
[illegible]	[illegible]	—		—
[illegible]	[illegible]	Pastoral:	[illegible]	
		Agricul.	[illegible]	
			[illegible]	[illegible]

The 1948 census gives the following figures: 161

		Male	Female	Total
Kenya	Narok Kajiado Samburu* Il Chamus	[illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible]
		[illegible]	[illegible]	[illegible]

* Estimated.

		Male	Female	Total
Tanganyika Territory	[illegible] [illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible] [illegible]
		[illegible]	[illegible]	[illegible]
Total for Masailand		[illegible]	[illegible]	[illegible]

This shows only a small increase over the 1931 estimate for the Kenya Masai, when 10,000 Samburu are deducted; but it doubles the previous estimate for the Samburu and shows a substantial increase in the Tanganyika Masai.

The livestock estimates for the Kenya Masai are: 391 433

	Cattle	Goats and sheep	Donkeys
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] to [illegible]	[illegible]	[illegible]

The figures for cattle among the Tanganyika Masai are [illegible],[5] but these may be underestimated. They vary in fact from about [illegible] to [illegible] according to season and other factors.[6]

The total area of Masailand in Kenya and Tanganyika is about 41,000 square miles or 26,240,000 acres (15,000 square miles or 9,600,000 acres in Kenya, and 26,000 square miles or 16,640,000 acres in Tanganyika). After deducting 3,000 square miles or 2,000,000 acres from the Kenya Land Unit as being useless on account of bush or tsetse fly, the Kenya Masai have about three acres per head of stock which is shared with sheep and goats; whereas in country such as theirs cattle alone require anything from three to five acres per head, owing to the low rainfall, poor grazing, scarcity of rivers, and frequent droughts. Their Land Unit is also a Game Reserve. 131 911

SOURCES: Sandford, 1919; E.A. Census, 1948.

PHYSICAL ENVIRONMENT

At the height of their power in the middle of the 19th century the Masai occupied a stretch of country which covered some 500 miles from north to south, and, at its widest, 100 miles from east to west. The northern limit was approximately Lake Suguta (now mud flats), 20 miles south of Lake Rudolf; the southern, [illegible], near 175 134

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[5] F. H. Page-Jones, "Water in Masailand," TNR, 1948, p. [illegible].

[6] Information from Mr. H. A. Fosbrooke.

175 Kisin, some 50 miles south of Kibaya in Tanganyika. The most northerly Masai
131 were (and still are) the Samburu, who in 1889 extended more than 120 miles north-
wards towards Lake Rudolph. This vast country, with an area amounting to some
133 80,000 square miles, now reduced to one-half its original size, has great varieties of
altitude, climate, rainfall, and vegetation. There are three vegetation zones: the
low or northern has desert scrub and a desert type of grass; the second or medium
zone has thorn bush and medium grass; the third or highland zone has evergreen
forest, parkland, and tall grass. In Kenya, the altitude of Masailand ranges from
4,000 to 6,000 ft., though in the highlands which lie between Narok, Kilgoris and
[illegible] to zone 3 the land in some places rises to 10,000 ft. Most of the present
Masai Land Unit is in zone 2; part of the extreme northern territory of pre-European
times is in zone 1. In Tanganyika, the Masai territory is at a lower altitude, ranging
from 3,000 to 6,000 ft., and including the isolated mountains Kilimanjaro and Meru.
Much of this country is waterless, and belongs to zone 1. In Tanganyika Masailand,
there is one permanent river, the Ruvu or Pangani, on the eastern boundary; there
are a few seasonal rivers, but for their main water supply the Masai depend on wells,
water-holes, and springs. Since only the third zone is well watered, and most of
the Masai live in zone 2, their life is conditioned to a great extent by the water
supply, and in the sunny season a form of transhumance is practised. In the present
Masai Land Unit in Kenya, the rivers are few, and the rainfall low. Most of the
few large rivers run close together in flat country useless for grazing; the main
stream, too, run in the [illegible] and [illegible] less than halfway across the Land Unit to [illegible]
[illegible], the [illegible] give. There are no lakes except the soda lakes Magadi, Natron,
and Naivasha, though in the northern part formerly occupied by the Masai is the
chain of lakes Baringo, Hannington (salt), Nakuru (salt), Elmenteita, and
Naivasha. The Rift Valley, in which these lakes lie, runs right through Masailand
from south to north. In many places the floor of the valley is a wide grassy plain;
in others, as in the Kerio Valley, it is narrow with high precipitous walls. The rain-
fall is low, the average for the eight years 1910-17 and 1920-? at Narok being
19 ins., with a range of 47 ins. to 12 ins. It is recorded that at Longido in one year
there fell only 8 ins., three of them in one night. With such a rainfall, grazing
cannot be anything but scanty. The average rainfall recorded by three gauges in
the Masai steppe between Kibaya and Arusha for nine years is 20.8 ins. There are
two seasons, the dry weather from June to November, followed by short rains in
November and December, after which there may be rain in January and February
(January: 1915, 0.00 in.; 1916, 0.20 ins.; 1917, 0.60 ins.; February: 1915, 1.00 ins.;
1916, 0.00 ins.; 1917, 0.20 ins.; though in 1918—a dry year in Kenya—there was
only 0.28 in. in February). The dry weather is called "the months of hunger" by
the Masai. The exceptional wet season is from March to May, "the months of
plenty," though small amounts of rain may fall in other months, notably June to
August, which are called "the months of showers." The figures given for Kenya
refer only to Narok, and in the more arid parts there is not only less rainfall, but
the small precipitation out of season has little effect on grazing or water supply.
Except in the highland zone, where there is some seasonal variation, day tempera-
tures vary only between 60° and 65° F.

SOURCES: Thomson, 1885; Sandford, 1919; Page-Jones, 1948; James, 1939.

MAIN FEATURES OF ECONOMY

Settlement Pattern

361 In dry weather the cattle graze round the permanent waters; in the wet season
320 the cattle are driven to the temporary waters that form, leaving the grass round the
permanent waters to rest. In both seasons the kraals are built a few miles from the
233 water supply. On one day the cattle are taken to drink, and on the next day they
361

are taken in another direction, which means that they drink only on alternate days, but at the same time graze over a larger area than if they went to water every day, thus helping to conserve the grazing. There are two types of kraal. The married men with their wives and children live in one type, and the warriors with their mothers, sisters, and girl lovers in another type. The main structural difference between the two types seems to be that the warriors' kraal has no fence, while the elders' kraal is surrounded by a thorn fence. The elders' kraal varies in size; it may contain from seven to several hundred huts, though very large examples (such as were seen by [illegible] and von Höhnel) are probably uncommon; the average is probably about [illegible] to [illegible]. The warriors' kraal may contain between [illegible] and [illegible]. In the elders' kraal the huts are built round the inside of the fence, which is also the enclosure in which the livestock are housed at night. The number of gates in the fence depends upon the number and size of the families which live in it. Each family has exclusive rights over at least one gate, and a large family with many cattle has more than one. The kraal, [illegible], thus approximates to a village, for several families live in it, and the gate, [illegible], has come to typify the family, the word being used with the article ([illegible]) as a synonym for [illegible], "the family." When a man sets up his home in a kraal, he puts his first wife in a hut on the right of his gate as one goes in, and the second wife on the left, the third, if he has one, goes on the right, and the fourth on the left, and so on, the huts being so arranged that each succeeding wife lives immediately to the right or left of her gate. The people on each side of the gate form two distinct groups, [illegible], the effect of which is felt most in matters of inheritance. (See below, p. [illegible].) The warriors' kraal or *e-manyata* is inhabited by all the members of one age-set in one district, who constitute a company, [illegible], and the kraals are built in strategic positions. With the men live their mothers, and some young sisters who help their mothers, and if old enough become lovers of warriors. The mother, her warrior son, and younger children share a hut, all sleeping on separate beds; when the warrior wants to sleep with his lover he goes to another hut. The mother's husband may visit her at any time, and when he comes her hut must be given up to the pair. The inhabitants of a manyata vary considerably in number, ranging from [illegible] to several hundred.

LIVESTOCK

Cattle

Cattle, as [illegible], are the object on which the lives of the Masai are centred, and on which their whole existence depends. Their importance is both material and spiritual, and people who perform any kind of work other than herding cattle are despised by the Masai, whose attitude towards cattle is similar to that of the Nandi. The Masai believe that in the beginning God gave them all the cattle in the world, and therefore nobody else has a right to possess any. Cattle provide the Masai warrior with his food in the form of milk, blood, and meat, and they give him spiritual and mental satisfaction through their existence, though it would seem that there is less outward and ritual expression of the love of cattle than among some other East African tribes who combine pastoralism with agriculture. This, however, does not by any means indicate that the Masai are an agricultural people who have wholly given up agriculture and taken to pastoralism. Since the Masai, unlike the Nandi, kill large numbers of their cattle for eating, it was essential in the past for them to maintain the size of their herds by continual raiding, for the natural reproduction rate would not have been enough. On account of its high ritual value, milk may not be drunk on the same day that meat is eaten, nor may it be boiled; but it may be drunk mixed with blood. Grass also has a high ritual value, being the food of cattle, and is used as a sign of peace. In 1930 the average size of an elder's herd was officially estimated at about 75 head of cattle, [illegible] sheep and goats, and [illegible] donkeys; this was based on the estimate of 720,000 as the total number of cattle belonging to the Kenya Masai. In Tanganyika, it was found that the average number

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[illegible] of cattle in a family ([illegible]) in 1905 was between 100 and 800 head. There appears to be no such system as the Nandi [illegible] or Kipsikis [illegible]. (See Merker, p. [illegible].) Milking is done by girls and women into gourds; the calf is allowed to suck, and if it dies its skin, sometimes stuffed with grass and called [illegible], is presented to the cow at each milking. The milk yield is about three pints a day. Cattle are bled in the same way as by the Nandi, with a blocked arrow, shot point blank into the jugular vein, and the blood is caught in a gourd. Sheep also are bled. Cattle are branded with marks on the rump or flank which indicate the owner's clan or sub-clan, with sometimes a private mark as well; the ears are also clipped for the same purpose. Salt for cattle is obtained by driving the herds to a salt-lick, [illegible]. The Masai are said to have effective remedies for diseases of cattle, but their efficacy has never been enough to prevent heavy loss during epidemics of rinderpest and pleuro-pneumonia.

Donkeys

[illegible] The Masai keep large numbers of donkeys (sing. [illegible], pl. [illegible]) which are used for carrying their goods when they move house ([illegible]). Donkeys are marked by slitting the ears in different ways.

The Status of Cattle

[illegible] The status of cattle as regards ownership is uncertain. Hollis says that warriors may own cattle. Thomson says they may not, and on such a point the statements of a traveller are open to question. Fosbrooke says that they may.* But further investigation of cattle as property, and of their status in the light of ritual value is required.

INHERITANCE OF CATTLE

[illegible] There does not seem to be any clear account of the rules which control the division of a man's stock among his sons. The guiding principle is that the eldest son of the senior wife gets the largest share, inheriting not only the cattle given in trust to his mother, but also those which his father had kept for his own use. Inheritance is affected also by the "gate" ([illegible]) arrangement in the kraal;‡ the cattle may not pass from one side to the other. If a wife on the left side dies without sons, her cattle may not go to a wife on the right side as long as there are any sons by other wives on the left side. This subject also needs further investigation.

GRAZING AND WATER RIGHTS

[illegible] Land is not owned by individuals, but by the sub-tribe ([illegible]), and grazing rights are acquired by residence. Water rights are controlled by the clan. In the old days, when the Masai occupied new territory, each warrior, according to tradition, claimed a well, spring, or water-hole on behalf of his clan. Individual rights over water are thus vested not by tradition, and the senior member of a clan living at the water decides, after consultation with other clansmen, the order in which people take their cattle to water. But a Masai when actually on the move with cattle may claim, and must be given, priority over local cattle at any well or spring. Where water is plentiful, however, as in a river, possession is communal.

DIVISION OF LABOUR

[illegible] In a purely pastoral society like that of the Masai the expression "economic unit" has little meaning, but so far as it can be said to exist, it is the family. It must be remembered, however, that the normal practice is for families to be divided between the father's kraal, *[illegible]*, and the warriors' kraal, *e-manyata*, and that the

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* Fosbrooke, personal communication.

‡ [See details of the ([illegible]) arrangement in residence, on p. [illegible]. -- [illegible]]

[illegible] is of little economic significance, except that it is the duty of the warriors to get cattle by raiding. In the division of work, the people mainly concerned are the uncircumcised boys, the girls, and the women. The boys do most of the herding, assisted by the elders. Women and girls milk and act as servants to the warriors. The girls do household work (if they are old enough to become lovers of the warriors, when they do very little work). The greater part of the work thus falls on the older women, who besides doing or supervising the milking and other ordinary household tasks like fetching water and firewood, build the huts, load and drive the donkeys when moving, prepare skins for clothing, and trade with neighbouring tribes for food and other things. The warriors used to be occupied principally either with war or preparations for war, or with dancing, visiting, and making love. Their military activities have today been replaced by certain tasks connected with cattle, and by cattle-stealing and raids on neighbouring tribes. The senior elders are occupied with political matters, and some of them with the instruction and control of the initiates and younger warriors; they also help with the herding, and take part in trading with the neighbouring peoples.

The only specialists in the economic sphere are the smiths, *il-kunono*, sing. *ol-kunoni*, who live segregated from the rest of the Masai, and marry among themselves. They have a distinctly inferior status and are despised by the Masai, who oil their hands before taking anything from a smith. At one time the smiths found some deposits of iron ore, such as those in the [illegible] area, but nowadays the availability of trade-iron has given them greater [illegible] of materials. They make the iron-work used by the Masai, including spears, swords, and ornaments.[1]

Though according to Hollis a few Masai women made pottery, the Masai as a rule buy their pots from the Bantu.

FOOD

Except among the agricultural Masai, no cereal or vegetable food at all is grown, nor was it eaten in the old days by warriors, whose diet consisted of meat, milk, and blood, the latter providing the necessary salt. The animals eaten included [illegible] cattle, buffalo, *ol-[illegible]*, and eland, *o-[illegible]*, which they considered to be related to cattle, and therefore fit to eat.[2] Warriors were not allowed to eat honey, to drink honey-wine, or to take tobacco, though some took snuff. Children and married people eat vegetable food, and the meat of cattle which die a natural death. Warriors when they want to eat meat, build a rough shelter called *ol-pul* in the bush where, accompanied by a boy to do the work, [illegible] gorge [illegible] upon the meat of an ox supplied by the father of one of their number. The elder who supplies the ox is given some of the meat, and this is one of the regular sources of meat for married people, the meat-eating is the regular practice of warriors. Men and women do not eat together, and fish, fowls, eggs, and game other than buffalo and eland are not eaten by any Masai.

TRADE

Since the Masai are not self-supporting, they have to trade with the Bantu agriculturists, *il-meek*, whom they despise, in order to get what they want. Their chief suppliers are the Kikuyu, Chaga, and Taveta, and for certain things, notably ivory and honey, the Dorobo. The media of exchange are cattle (old, barren, and otherwise unsatisfactory ones), old and thin goats and sheep, donkeys, butter, and hides. The principal goods bought are food (beans, millet, maize) and tobacco, which they get from the Bantu; the chief suppliers of metal are Indian traders, often Sikhs.

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[1] Leakey says that the Masai buy their swords from the Kikuyu ([illegible], p. [illegible]): this may well be the case near the Kikuyu border, though it is perhaps a recent development.

[2] The Galla also consider the buffalo to be the equivalent of the ox. Bahrey, *[illegible] Galla*, chap. [illegible], Galla.

THE SOUTHERN NILO-HAMITES

479 [illegible] appear to be the Masai. Honey, honey-wine, and ivory are got from the Dorobo. Ivory was used in the old days for trading with the Swahili caravans for cloth, beads, wire, and so forth. Trade outside Masailand is conducted mostly by the women, for by mutual arrangement they were allowed to pass unharmed from tribe to tribe even during the progress of a war. [96]

Hunting

[illegible] Though the Masai do not hunt habitually, and despise those who do, they used occasionally to kill wild animals—elephants for their tusks, buffalo and eland for the meat and hides, ostriches for their feathers, and lion and leopard to protect their cattle.

Labor

[illegible] Although deprived of their only real occupation, fighting, the Masai have not yet as a people accepted any substitute for it, being, as Sandford noted, "too proud to work," i.e., for wages. A small number have accepted employment as herdsmen on farms, and some have done good service in the Police and K.A.R., though even in a military capacity most of them are still unwilling to submit to a form of discipline that is not their own. Though a few have taken to cultivation, the majority have not yet consented to stoop to what they consider labour unworthy of a Masai.

Sources: Thomson, 1885; Hollis, 1905; Johnston, 1902; Merker, 1910; Sandford, 1919; Fosbrooke, 1948, and personal communications.

THE AGRICULTURAL MASAI

103 (113) The agricultural Masai, the Il-Lumbwa (Lumbwa) and Il-Oikop of former days, are people of Masai stock who, having lost their cattle through disease or defeat, were forced to take up agriculture in order to survive, and by so doing earned the lasting contempt of the pastoral Masai. It is in most cases uncertain how long the various groups of Il-Oikop have been agriculturalists; some of the southern Masai, for example, were defeated by the Gogo early in the 19th century and took to agriculture. Fischer in 1882 reported groups of "Wakwavi," as he called them, living on the southern edge of the [illegible] ([illegible]), 12 miles southwest of [illegible]; in the region known as [illegible] ([illegible], "the farms") for about 20 miles north of Lake Natron; at the southern foot of Mt. Meru; and at Kahe.[8] Von Höhnel adds [illegible], 20 miles north-west of Lake Natron.[9] Another group is named by Thomson and von Höhnel[10] at Taveta; while the map in Hollis's *The Masai* shows them as extending for about 150 miles south-southwest of Lake [illegible]. The best known, however, are the northern group called Il-Tiamus or En-jemusi (Njemps) near Lake Baringo, concerning whom we have (such as it is) the fullest information.

184 82 With the exception of the Taveta group, the agricultural Masai in general resemble the pastoral Masai in appearance, dress, and general culture, and though they cultivate the ground, still have the acquisition of cattle as their chief ambition. Those of Taveta have mingled with the Taveta,[11] and have become the most successful cultivators among the Masai; the rest of the agricultural Masai in the days of Thomson and Teleki grew mainly [illegible] and millet, while the Il-Tiamus grew also pumpkins, and tried unsuccessfully to grow maize. Most of the agricultural Masai supplemented their diet by hunting, bee-keeping, and, where possible, by fishing.

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[8] See *Massai-Land*, 1885, map at end.
[9] *Discovery*, etc., II, p. 9.
[10] *Through Masai Land*, chap. III; *Discovery*, etc., II, pp. [illegible]
[11] Called by the Masai il [illegible], sing. ol [illegible].

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13:Huntingford E-4 (no date) 1953 FL12 Masai FL12
Agricultural Masai

In 1952 the Il-Tiamus numbered about 2,000 (1,400 according to the 1948 Census), and though they are of Masai stock, being descended from a Samburu section called Il-Ngwesi, they have admitted a variety of refugees including Samburu, and become rather mixed. According to von Höhnel they had originally two villages at the south end of Lake Baringo, but one was deserted on account of floods and lack of food, and some of the inhabitants, having lost all their cattle, took refuge on an island in Lake Baringo. They are expert swimmers and possess canoes, though von Höhnel saw none in 1887. Their dwellings are round huts with rather high-pitched and somewhat convex thatched roofs, and walls of posts and sticks. These are crowded into two permanent villages known as "Njemps Kubwa" and "Njemps Ndogo" in the Tigrish valley a few miles south of Lake Baringo; the closely packed huts almost touch each other, and the mud-walled granaries are surrounded by strong palisades.

In general the Il-Tiamus keep as close as they can to the dress and customs of the pastoral Masai; they have circumcision and clitoridectomy and other ceremonies, and practise the "age-class" system of the pastoralists, though without the manyattas. Today they have some 100,000 acres of poor land, most of it unfit for cultivation, but they have acquired, since the establishment of British rule, some 12,000 or more head of cattle, and 20,000 goats and sheep, thus achieving in part the ambition of all Il-Oikop to become cattle people again. In the time of Thomson and Teleki, however, Njemps was an important station on the caravan route, and von Höhnel noted that they had a large extent of cultivated land. This was divided into blocks (in area of three to four miles square) which were intersected by irrigation channels bringing water from dams across the river Tigrish. This system was still working in Dundas's time, who says that the opening of the main ditch was performed with the sacrifice of a sheep at the mouth of the ditch. Besides agriculture, the Il-Tiamus fished and hunted, using the bow, and spears of Suk and Turkana types.

It is possible that the fishing group called El-Molo who live on the east shore of Lake Rudolf is to be classed as Il-Oikop. They subsist on a diet of fish alone which, when Teleki and von Höhnel saw them in 1888, had produced no ill-effects; but it seems now to have resulted in considerable physical degeneration, and in the appearance of rickets in all members of the group. There seems to be a good deal of Galla blood in them.

The Il-Arusa round Mount Meru are a large tribe of agricultural Masai, originally of Bantu stock, but now accepted by the pastoral Masai as worthy of recognition as a group which can pay and receive cattle for compensation in cases of homicide. The Bumaguyu in Southern Masailand are also to be classed as agricultural Masai.

SOCIAL ORGANIZATION AND POLITICAL STRUCTURE

SOCIAL ORGANIZATION

Life Cycle

From birth to circumcision a male is a boy, *ol-ayioni*. At circumcision he enters an age-set and becomes a warrior, *ol-murrani*, "one who is circumcised," and may associate with unmarried girls. At the *ol-geher* ceremony he becomes an elder, *ol-moruo*. Warriors may marry when they become senior warriors. After the *ol-geher* the newly made elders attend to their family concerns, and get wives

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K. R. Dundas, *JRAI*, XL, pp. 49-53.

W. S. Dyson and V. E. Fuchs, "The Elmolo," *JRAI*, 1937, LXVII, p. 327; von Höhnel, II, pp. 130-40.

The people known as Wakwavi in northern Tanganyika are not Masai, but people of Bantu stock who have imitated them.

There is some uncertainty as to the age at which boys are circumcised. Hollis gives the limits as 12-17 years; Fuchs gives the lower limit as 10 or 12.

.561 if they are not already married. They have duties also towards the uncircumcised boys as guardians and instructors, while the elders of the *ol-aji* senior to them (see p. 117) are said to be responsible for the *ol-aji* of the warriors. One hundred years ago Krapf wrote that the Masai had six age-divisions: "(1) Engera, little children. (2) Leiok, boys. (3) Elmoran or elkeiteau, from 17 to 20 or 25 years of age. These have not yet married wives, nor obtained cattle of their own. . . . (4) Elkieko, who marry and have cattle of their own. (5) Esabuki, older than the Ekieko. (6) The Elkijaro or Elkimirisho, the aged persons."[14] A woman is classed as a girl (small, *en-kiyio;* older, *en-tito*) till married, when she becomes *e-siankiki,* "young married woman," and then *en-kitok,* married woman.

Kinship and Behaviour

601 [171] The Masai kinship system stresses agnatic descent, and in this respect differs somewhat from the kinship systems of the Nandi peoples; but the distinction between agnates is not taken into the third and second ascending generations. The Masai system is therefore different from the Nandi *tiliet;* and though the word *-sotua,* meaning both "peace" and "relative" occurs in the Masai system, it is not used with the group-significance of the Nandi term *tiliet.* The Masai system has not yet been studied in detail, and the following analysis is based mainly on Hollis's account, the fullest that we have.[15] Certain alterations and additions have been made after discussion with John Tombo ole Mbaei; but there are considerable discrepancies between him and Hollis, and this analysis must be regarded as purely provisional.[16]

There are 11 terms used of both kindred and affines, together with two others used only of affines. The words *koko, papa,* and *yieyio* are used without gender signs; *koko* is derived from *enk-oko; papa* and *yieyio* are the correct words for "father" and "mother" (not *menye* and *yolo,* which mean "father of" and "mother of"). *Apu* and its derivatives take gender signs (*ol-apu, o-le-nk-apu, en-e-nk-apu, ol-aputani, enk-aputani*); as do *akui* or *akuyia* (*ol-akui, enk-akui*); *sotua* (*o-le-sotua, en-e-sotua*); *e-sindani* (only feminine); *ol-ayioni, en-tito,* meaning son and daughter (both covered by *en-kerai,* "child," referring to either sex); and *ol-alashe,* brother, *enk-anashe,* sister, which have in addition the internal change of L to N indicating the feminine.

In the third ascending generation all males are *ol-akui* and all females *koko.* In the second ascending generation, all males are *ol-akui,* except the father's mother's brother, who is *ol-apu.* The wives of all *-akui* are *koko;* but the wife of *ol-apu* is *yieyio.* The husbands of *koko* are: (1) of father's brother's sister, *ol-aputani;* (2) of father's mother's sister, mother's father's sister, mother's mother's sister, *o-le-sotua.*

In the first ascending generation, the father and his brothers are *papa,* the mother and her sisters *yieyio,* as well as father's sister. Mother's brother is *ol-apu.* Father's brother's and mother's brother's wives are *yieyio;* husband of father's sister is *ol-aputani,* of mother's sister, *o-le-sotua.*

In a man's own generation, brother and father's brother's son are *ol-alashe,* and their wives *e-sindani,* brother's wife being distinguished as *e-sindani e-anyit* to indicate closer relationship. Sister and father's brother's daughter are *enk-anashe,* and their husbands *ol-aputani.* Father's sister's son is *ol-apu,* and his wife *yieyio;* mother's brother's son is *o-le-nk-apu* and his wife *yieyio.* Father's sister's daughter is *en-e-nk-apu* and her husband *o-le-sotua,* a term applied also to mother's sister's son and daughter (masc., *o-le-,* fem., *en-e-*), and to the husband of the mother's brother's daughter, who is *en-e-nk-apu.*

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[14] *Vocabulary,* pp. 14, 15. In modern spelling, the Masai words are *en-kerai, il-ayiok, il-murran.* The remaining words are names of age-sets. (See p. 116.)

[114] [15] *JRAI,* 1910, XL, pp. 473–82. This supersedes Merker's account in *Die Masai,* pp. 40–3. There is an excellent analysis of the Masai system by Radcliffe-Brown in *African Systems of Kinship and Marriage,* pp. 16–22.

[16] It may be mentioned, however, that the use of terms within a tribe is not always uniform, as I have found among the Nandi; and this may sometimes account for apparent discrepancies.

In the first descending generation, the word *en-kerai*, " child," may be applied 601 to son, daughter, brother's son and daughter, and father's brother's son's son and daughter, or they may be distinguished as masc. *ol-ayioni*, " boy," and fem. *en-tito*, " girl." Father's brother's daughter's son is *ol-aputani*, and father's brother's daughter's daughter *en-e-sotua*, the latter term applying also to father's sister's daughter's daughter, and mother's sister's son's daughter. The term *o-le-sotua* is applied to the mother's brother's daughter's son, mother's sister's son's son, mother's sister's daughter's son, and father's sister's daughter's son. *O-le-nk-apu* is applied to the sons of father's sister's son and mother's brother's son, and *en-e-nk-apu* to their daughters. In this generation there are no terms for mother's brother's daughter's daughter, and mother's sister's daughter's daughter.

In the second descending generation, *ol-akui* includes the sons of a man's own son and daughter, brother's son, father's brother's son's son, father's brother's son's daughter; while *enk-akui* is applied to their daughters. Father's brother's daughter's son's son is *ol-aputani*, and the daughter is *en-e-sotua*. The term *o-le-nk-apu* covers son's son, and the sons of sister's son, father's sister's son's son, and mother's brother's son's son; their daughters are *en-e-nk-apu*. *O-le-sotua* includes the sons of sister's daughter, father's brother's daughter's daughter, father's sister's daughter's son, father's sister's son's daughter, mother's brother's son's daughter, mother's brother's daughter's son, mother's sister's son's son, mother's sister's son's daughter, and mother's sister's daughter's son; *en-e-nk-apu* is applied to the daughters. There are no terms for mother's brother's daughter's daughter's son and daughter, or for mother's sister's daughter's daughter's son and daughter.

Among affines, the term *ol-aputani* is applied to wife's father, wife's father's brother, and wife's brother, but their wives are *enk-aputani*, *en-e-sotua*, and *en-e-sotua* respectively. Son and grandson of wife's brother are also *ol-aputani*. Wife's sister is *e-sindani e-anyit*, and all children and grandchildren of wife's brother and sister (except wife's brother's son and grandson) are *-e-sotua*. The majority of affinal terms are in fact of the *-e-sotua* category. Husband is *ol-moruo* or *ol-payian*, wife *e-goroyioni* or *en-kitok;* junior wife is *enk-aini*.

These kinship terms, however, are not very much used, for it is the custom of 551 the Masai to call each other by cattle-names: members of a domestic group give each other cattle on various occasions, and thereafter the word denoting the kind of animal given is used as the equivalent of a reciprocal relative term; the animal name is prefixed by *pa*, meaning " giver or receiver of." Thus, a father usually gives his son a bull when he is about 10 years old, and they then call each other *pa-oigoni*, " giver (receiver) of a bull " instead of *papa* and *li-ayioni*. An elder brother will give a younger brother a heifer, and they will then be *pa-n-tawuo* (heifer) to each other. Paternal cousins often call each other *pa-meregesh* (ram).

Among these relatives, the mother's brother has great power and influence over 604 his sister's son. He can give him orders, which must be obeyed, and he may take what he wants from his nephew, who has also the right to take what he wants from his uncle. Refusal to obey the mother's brother can be punished by cursing, but 602 this is not reciprocal. Behaviour patterns are based on seniority and the claims of kinship, and are expressed in the avoidance of bad language and unseemly actions, and the observance of formality between certain persons. There is avoidance 606 between a man and his wife's mother, and between a man and his full brother's 607 wife, though not between him and his half-brother's wife. The formality of greetings helps to preserve the respect for elderhood. 888

Pre-marital Sex-life

A man's sex-life begins when he has been circumcised; a girl's when she reaches 836 puberty. Pre-marital relations are more formalized than among the Nandi, since the unmarried warriors of a local company, *sirit*, live in a barrack, *e-manyata*, with their mothers, some of their sisters, and their girl lovers, *e-sanca*, each man having his own lover. The rules which regulate marriage apply in the selection of a lover.

Betrothal

584 A man usually chooses his wife himself and, after obtaining the girl's consent, asks his father to approach her parents; if they agree the girl's head is smeared with fat, and she may no longer live in the same kraal as her betrothed. According to Hollis, a man makes the first approach to the girl's father himself, giving him first tobacco, and later on when the girl is older, more tobacco and honey. It is considered wrong for a girl to become pregnant during the betrothal period, and the engagement may be broken off, a custom of which advantage is taken by girls who are betrothed to a man they do not wish to marry, since betrothals are sometimes arranged without the girl's consent. Fathers, for instance, sometimes arrange betrothals between their young sons and daughters in order to strengthen the bonds of friendship between them (as also among the Nandi); and betrothals may take place between warriors and babies, and even unborn girls.

Regulation of Marriage

582 614 This depends on three things: clan, age-set, and kinship. (*a*) According to Hollis, marriage between clans is allowed, but sub-clans are exogamous groups (see below, p. 119); a man may marry a woman of another sub-clan of his own clan. Merker says he may not marry a woman of his mother's sub-clan. Tombo ole Mbaei, however, says that though intermarriage between clans is allowed, each clan is an exogamous group; Fosbrooke agrees that the clan is the exogamous group (see p. 120). (*b*) A man may not marry a woman who is by custom considered as belonging to the age-set (*ol-porror*) senior to his own, to his own age-set, or (if he belongs to the Right-hand Circumcision) to a woman of the Left-hand Circumcision. But he may marry one of the same generation"[19] (*ol-aji*). See below, p. 117, for details of the age-set system. (*c*) A man may not marry a woman whose relationship to him is closer than that of third cousin, and then only if they call each other *o-le-sotua* and *en-e-sotua*.

Bridewealth

583 Payment of bride-cattle establishes the husband's rights in his wife's procreative faculties and over the children she bears him. The numbers of stock paid seem to vary slightly. Merker gives them as three cows and one ox to the girl's father (the ox being eaten at the marriage feast), and a ewe and ram to her mother (the ram also being eaten). Hollis says the bride's father is given three heifers and two oxen, one of which is slaughtered " at the door of the hut "; on account of the other ox the man and his father-in-law call each other *pa-kiteng*, " giver and receiver of an ox." To the bride's mother are given two rams, which are slaughtered, and a ewe, on account of which he and his mother-in-law call each other *pa-ker* (sheep). Fosbrooke gives the number as two oxen and three cows or heifers, including the " *pa-kiteng* " ox.

Marriage

585 There appears to be little ceremonial at a wedding. The chief occurrence is a feast at the bride's home, of which the bride and bridegroom do not partake. This is followed by a ceremonial journey of the bride to her husband's home; she wears a freshly oiled garment, carries a gourd ornamented with cowries, and is accompanied by two men and two old women; on her arrival, she is given a child to feed. [391] Thomson says that on the day of marriage and for a month afterwards (if I understand him aright) the husband wears female dress.[20] If the husband is still a warrior he may not have sexual intercourse with his wife, though they may live together at

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[19] Merker, p. 47.

[20] Discrepancies between authorities may sometimes be due to difference of tribe, and not always to incorrect information or mere misunderstanding.

his father's home or in his own *manyata*. But it seems that a ceremony is performed 585
which releases the husband from the prohibition on warriors having sexual relations
with married women.

A widow is looked after by her husband's brother, or by one of her own brothers; 587
she may cohabit with her husband's brother. It appears that a woman who has 837
had children may not marry again, though one who is childless may marry her
husband's half-brother, if he has one. Any children she may have after her 848
husband's death are counted as his.

Polygyny

A man may have as many wives as he can pay for: one of Hollis's texts says 595
that a rich man may have as many as 20. Actual figures show that while two wives
are common, three and over are found much less often, and more than five very
seldom. Each wife has her own hut in the husband's kraal, *enk-ang*, the first wife
on the right of the gate as you go in, the second on the left. To each wife are
allocated cattle which she holds in trust for her children.

Adultery

Adultery is not common, because the rules controlling sexual relations are wide 837
and elastic. Any of a man's age-mates (members of his own *ol-aji*) may have access
to his wife, and though men of one age-set are not supposed to associate with the 684
wives of another age-set, in practice this rule is little observed. A warrior is not
supposed to have intercourse with a married woman, and a married woman may not
have sexual relations with an uncircumcised boy.

Divorce

A wife cannot be divorced once she has borne a child, though a temporary 586
separation may occur, the wife, if the husband is at fault, going to one of his age-mates, or, if she is at fault, to her father.

Adoption

In the old days, children captured in war were often adopted; and even today, 597
children of "foreigners" (those who are not Masai) may be adopted, especially in
times of famine. Such children become accepted as Masai. Under the term "adoption" is also included the practice of adopting children within the family, e.g., a
father will adopt a child of his wife's which has been begotten by another man, and
a barren wife may adopt a child of one of her co-wives.

Birth and Naming

Birth takes place in the mother's hut, where she is attended by a midwife, *enk-* 844
aitoyioni. The women and girls of the kraal assemble, and after the child has been
born they feast on an ox supplied by the father; next day another ox is killed for
the rest of the people of the kraal. The mother remains in her hut till she feels 846
strong enough to go out; the husband may not enter the hut for 10 days, nor eat in
it till the child can walk. Intercourse between husband and wife stops as soon as 843
the wife knows she is pregnant, and is not resumed till the child is weaned, when it
is between one and two years old. (Hollis says till the time when it cuts the two 833
middle incisor teeth, upper and lower.) Twins are considered very desirable, and a 845
boy is preferred to a girl.

The first name is given either on the fourth day after birth, when the child is 553
taken outside to be shown the sun, or at a feast held on the 10th day, which begins
with the killing and cooking of an ox: the meat is distributed to the inhabitants 852
of the kraal, and in the evening the mother, carrying the child on her back, milks
the cows. After this, the child is named in the presence of the father and mother

553 and three old men. If it has not previously received a name, it may have been
852 called by the name of its father's father; but at the naming ceremony it receives a
name which may be that of its father or a name not connected with any relative.
551 People are also given nicknames referring to their physical or other peculiarities.
There is much uncertainty about Masai names; but every man has a patronymic,
consisting of *O-le*, "son of," preceding his father's name; this he appears to assume
after circumcision. Girls after circumcision may be referred to as *E-na*, "daughter
of," preceding their fathers' name. At marriage, the husband gives his wife a new
name. The practice of tecnonymy is a regular feature. Before the circumcision of
his eldest son, a man becomes known as "the father of" So-and-so, i.e., if his son is
called Sendeu, he becomes Menye Sendeu; his wife similarly becomes Ŋoto Sendeu,
the mother of Sendeu.

551 The name of a dead child, woman, or warrior is not spoken again, and if the
768 name is an ordinary word, that word is no longer used by the family. Thus, if a
man called Ol-onana, "the gentle one," died, on his death the word *nana* would
be replaced in his family by some such word as *polpol*, "smooth."

Circumcision (E-murrata)

881 Boys' circumcision ceremonies take place at intervals of about three years, and
304 the circumcision period is "open" for about four years. Though the operation may
be performed on boys singly or in small groups, the whole number of those circum-
[171] cised at the same time throughout Masailand forms an associating group correspond-
ing in some degree to the Nandi *mat* (see pp. 31 and 49). Judging by the published
accounts, circumcision was a much less prolonged and ceremonious affair than among
the Nandi. Before a boy can be circumcised, the father must submit to what is called
em-polosata e-sita, "the passing of the fence." After making honey-wine, he stays
alone in a small hut outside his kraal, dressed as a warrior. After four days, some
elders bring him back to his kraal, where he is told to remove the warrior's clothes
and become an old man. His son may then be circumcised.

Circumcision begins with the shaving and bathing of the initiate; in the
afternoon after this has been done an ox or sheep is killed and eaten by the warriors
and elders of the neighbourhood. On the second day, the boy cuts a tree called at
[824] this time *e-latim*,[21] which the girls of the kraal carry to the door of the hut [in which
the boy sleeps?], where it is planted. On the third morning the boy gets up early
and sits outside to get cold; after sunrise he is circumcised, the operator being often
a Dorobo. From the fourth to the seventh day he remains at home, and then goes
out, shooting with blocked arrows at the girls, and with other arrows at small birds
[884 which he wears hung from his head. This is his occupation till he has recovered:
during this time he is known as *o-sipolioi* and wears the dress of a married woman,
292] including the *i-surutia* ear-rings, and an ostrich-feather on his head. After recovery
he is shaved, given weapons and warrior's clothes, and becomes *ol-barnoti*, "the
shaved one," i.e., a junior warrior. Till his local company forms its *manyata*, he
lives at home.

Girls undergo the operation of clitoridectomy in preparation for marriage. There are no special times for this. An ox or sheep is killed before the operation. During the period of recovery they are known as *e-sipolioi*, and wear on their heads a wreath of the Hyphæne palm, *ol-merisian*, or of grass, instead of an ostrich feather.

Age-sets

561 Unlike the cyclic age-sets of the Nandi division, those of the Masai are of linear type, that is, they do not work in recurring cycles and do not come into existence till they are required. Nevertheless, it is clear from the lists of Krapf (1854), Hollis (1905), and Fosbrooke (1948), as well as from the Taveta age-sets (Hollis, 1901), that some at least of the names are fixed and recur. In 1939 the names Il-Kisalie

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[21] *Zizyphus mucronata*; normally called *ol oilalei*.

and Il-Merisho are recorded by Fosbrooke from the Kisonko: the first is given by Hollis as occurring in 1806 among the Masai, and in 1774 among the Taveta; the second, in 1874 among the Masai, and in 1879 among the Taveta. Moreover, all the names in Hollis's list from Il-Merisho in 1874 to Il-Kinyoyo in 1791 are found in the Taveta system (Lumerisho, 1879, going back to Lukinyoo in 1684 by 15-year intervals).[22] This repetition of names suggests the possibility of an original cyclic system.

The actual working of the Masai system is still not absolutely clear, but Fosbrooke has done much towards solving the problem. The main facts seem to be as follows. A boy is not born into a set, as among the Nandi, for his set does not come into existence as a named group till after circumcision. About two years before a circumcision takes place, the elders of the set immediately senior to the existing warrior group (*ol-aji*) start the process of inaugurating a new set, at a ceremony called *em-polosata;* this, as we have seen, is described by Hollis as a ceremony performed by individual fathers (p. 116 above), while Fosbrooke regards it as a national ceremony performed by the *Il-keek-onyokie* in Kenya as a common ceremony for all Masailand. The elders who take part in the inauguration become the sponsors, *il-piron* (lit. "fire-sticks"), of the new set, and the guardians and instructors of the initiates, thus corresponding to the Nandi *moterenik.* The *em-polosata* is followed by a ceremony called *en-dugore,* "the cutting," which closes the current period of circumcision; at this ceremony the formal relationship of instructor and initiate is established. After this, there follows a series of activities called *en-kipaata,* beginning with a dance which gives its name to these activities.[23] Between now and the opening of the circumcision the boys go round collecting candidates for initiation. In each circumcision area the *il-piron* and a few boys also go to the tribal laibon, and apply for his sanction to open the circumcision. When they return, the boys elect a representative called *ol-aiguenani* (pl. *il-aiguenak*), "the [624] counsellor," who must have special qualifications of birth, physique, and social status, and is chosen from among those of their number who have distinguished themselves in the debates which are held frequently, and are in consequence called *ink-opir.*[24] The duties of the *ol-aiguenani* are to act as intermediary between the warrior company to which he will presently belong and the laibon, to maintain liaison with other companies, to arbitrate in disputes, and to organize raids. He is confirmed in his office by being given a black club which has been blessed by the *il-piron* elders.

Each age-group or "generation," *ol-aji* (pl. *il-ajijik*), is divided into two age-sets, *il-porrorri* (sing. *ol-porror*), the first or senior known as *e-murrata e-tatene,* "the right-hand circumcision," the second or junior as *e-murrata e-kedianye,* "the left-hand circumcision." Those of the Right Hand are circumcised first over a period of four years, and when the circumcision is finished the young warriors divide into *i-sirit* or companies formed on a territorial basis, each of which has its own barrack, *e-manyata.* Soon after this, the preliminaries for the formation of the next *ol-porror,* the Left Hand, are undertaken, i.e., the *em-polosata, en-dugore,* and *en-kipaata* as for the previous *ol-porror.* About seven years from the beginning of their circumcision period the Right Hand become senior warriors by means of a ceremony called *e-unoto,* "the setting up," for as junior warriors, during the three years or so between the end of their circumcision and the *e-unoto,* they have begun to fight the senior warriors (of the previous *ol-porror*) for the full privileges of warriorhood. These they get by means of the *e-unoto,* and at the same time they elect a ceremonial leader called *ol-otuno* (Kisonko, *ol-aunoni*). As senior warriors they may marry. About eight years from the beginning of the Right Hand circumcision the Left Hand

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[22] The Taveta are a Bantu tribe living to the east of Kilimanjaro; they have strong Masai connections.

[23] *En-kipaata* also means a dance held by warriors before a raid.

[24] *Ink-opir* means "ostrich feathers," and indicates seniority, as in the term *Il-cagen-opir* applied to the senior division of each age-set. The *ink-opir* are the lieutenants of the *ol-aiguenani.*

13:Huntingford E-4 (no date) 1953 FL12 Masai FL12

561 are circumcised, over a period of three to four years, forming their *sirit* in the same way as the Right Hand. The preliminaries for the formation of the next age-set (*ol-porror*) which will belong to another "generation" (*ol-aji*) then take place; and about seven years from the beginning of their circumcision period the Left Hand become senior warriors through their *e-unoto*. When the Right Hand of the next *ol-aji* is getting near its *e-unoto*, both the Right Hand and Left Hand of the current *ol-aji* go through the ceremony called *ol-gesher*, by which they become elders; this is about 21 years from the beginning of the Right Hand circumcision, and 14 from the beginning of the Left Hand circumcision. It will be noticed that since the *ol-gesher* is common to both Right and Left Hand, the Left Hand men have a much shorter period as warriors; hence the Left Hand is considered slightly inferior to the Right Hand. Fosbrooke thinks that the *ol-gesher*, performed by the Kisonko, is a common ceremony for all Masailand, just as the *em-polosata* is a common inaugural ceremony. At the *ol-gesher* the outgoing warriors remove their pigtails, and a ceremonial leader called *o-loo-surutia* is chosen for the whole outgoing *ol-aji* in place of the two former *il-oluno*.

TABLE TO ILLUSTRATE SUCCESSION OF IL-AJIJIK AND IL-PORRORRI
(Based on Fosbrooke)

Year	Ol-Aji		Ol-Aji	
	Right hand	Left hand	Right hand	Left hand
1	Em-polosata			
2	En-dugore			
3	En-kipaata			
4				
5	E-murrata			
6				
7	Form *manyata*	Em-polosata		
8		En-dugore		
9	*E-unoto*	En-kipaata		
10				
11		E-murrata		
12				
13			Em-polosata	
14		Form *manyata*	En-dugore	
15			En-kipaata	
16		*E-unoto*		
17				
18	Senior		E-murrata	
19	Warriors			
20	may	Senior		
21	marry	warriors	Form *manyata*	
22		may		Em-polosata
23		marry		En-dugore
24	*Ol-gesher*	*Ol-gesher*	*E-unoto*	En-kipaata
25				
26	End of ol-aji as a warrior force			E-murrata
27				
28				
29				Form *manyata*
30				
31				
32				*E-unoto*
33			Senior	
34			warriors	Senior
35			may	warriors
36			marry	may
37				marry
38			*Ol-gesher*	*Ol-gesher*
			End of ol-aji as a warrior force	

The members of each *ol-porror* are circumcised in batches. Each batch forms 561 an associating group throughout Masailand (like the *mat* of the Nandi), and has a permanent name which recurs in each age-set, and in each succeeding age-set. There are four such groups in the Right Hand; they are called *Il-capen-opir,* "the big ostrich feathers," senior;[33] *Il-perigotua lay,* "our swift runners"; *Il-kirimbot* (meaning unknown); and *Il-tareto,* "the helpers," junior. The Left Hand, being smaller, has, according to Fosbrooke, only the last three of these groups. Women [562] have no age-sets, but are considered to belong to the *ol-porror* which was in formation at the time when they were circumcised.

The main function of the age-sets was to provide a permanent source of man- [182] power for fighting, and through them are still taught discipline and respect for elders; they thus affect behaviour patterns. An attitude of respect is required of 561 junior to senior age-sets, while between members of the same set there is a relation- 701 ship of equality and a sense of solidarity in their relations with other sets. Membership of a set also involves restrictions on both pre-marital and marital relations, of which mention has already been made. In the old days, the duties of warriors were chiefly to raid, in order to maintain as well as to increase the numbers of cattle; and to defend the country. Warriors were not allowed to drink intoxicants, but they had a number of privileges, which included access to the unmarried girls, and the right to demand milk at any homestead, and to oxen for eating. Though officially their fighting duties have been replaced by certain aspects of cattle management, mainly watering and night herding, there is a constant tendency in some tribal sections to raid their neighbours.

Clans

Clans (*in-kishomin,* sing. *en-kishomi*) are divided into sub-clans or primary 614 divisions, *il-gilat,* sing. *ol-gilata.* They are dispersed throughout Masailand, among all the tribes (*il-oshon*), and are totemic and patrilineal.[34] It is not certain how many clans there are, and this uncertainty seems to exist among the Masai themselves. The exogamous unit is probably the *ol-gilata,* though Tombo ole Mbaei says that

	Hollis	Merker	Fosbrooke
Clan: Sub-clans:	Il-Aiser In-Kidoŋi Il-Parkeneti I-Lukumai Il-Partimaro	Il-Aiser En-Kidoŋ (1) Il-Parkeneti (1) I-Lukumai (1) Il-Partimaro (1) Il-Parsinko (2) Enk-aji nanyokie (2)	Il-Aiser En-Kidoŋ Il-Parkeneti Il-Partimaro Il-Parsinko Enk-aji nanyokie
Clan: Sub-clans:	I-Lukumai (According to Tombo ole Mbaei)	Sitayio (2)	I-Lukumai Kerin-kishu Sitayio
Clan: Sub-clans:	Il-Molelian Il-Molelian-aate Il-Mamasita Il-Pojos Il-Kipuyioni Il-Moshono Il-Masaŋua Il-Mokoreru	Il-Molelian Il-Mamasita (1) Il-Kipuyioni (2) Il-Masaŋua (1) Il-Mokorere (1) Il-Muinko (2) Il-Parserenko (2) Il-Parsinde (2)	Il-Molelian Il-Kipuyioni Il-Masaŋua Il-Mokorere Il-Muinko Il-Parserenko Il-Parsinde

[*continued*

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[33] In Nandi the senior *mat* is called *Cagenopir,* usually shortened to *Coginish.*
[34] On the authority of Tombo ole Mbaei.

1614

	Hollis	Merker	Fosbrooke
Clan:	Il-Mokesen	Il-Mokesen (1)	Il-Mokesen
Sub-clans:	Il-Mokesen-aate Il-Partalale Il-Kiporon Il-Tanap owuaru ?	Il-Partalale (2) Il-Kiporon (2)	[Pirda] Il-Kiporon [Kiveron] [Loiger]
Clan:	Il-Tarosero	Il-Tarosero (1)	Il-Tarosero
Sub-clans:	Il-Tanap-owuaru ?	Il-Meboni (2) Il-Kidogu (2)	Il-Tanap owuaru [Lais]
Clan:	Il-Meŋana	Il-Meŋana	Il-Aitayok
Sub-clans:	Il-Aitayok I-Siria Il-Marumae Il-Makuperia	Il-Aitayok (1) I-Siria (2) Il-Marumae (1) Il-Makuperia (2) Il-Pojos (2) Seroi-kineji (2) [Il-Parsais] (2) [Il-Kisikol] (2) [Il-Parmanki] (2) Il-Parsele (2)	Il-Makuperia Il-Pojos Seroi-kineji [Il-Parsais] [Il-Kisikon] [Il-Parmanki] [Mosejwa] [Mohono]
Clan:		Il-Marumae (1)	Il-Marumae
Sub-clans:		[Il-eberet] (2) Il-Marani (2)	[Il-eberet] Il-Marani Il-Parsele

the main clan itself, *en-kishomi*, is the exogamous unit.[27] The Il-Aiser clan is that to which all the principal laibons, *il-oibonok*, belong throughout Masailand. (See below, p. 122.) The above table of clans is compiled and adapted from the lists given by Hollis, Merker, and Fosbrooke.[28] The numbers 1, 2, in brackets in Merker's list denote the groups which Merker calls *geschlecht* and *untergeschlecht* respectively.

Fosbrooke has also Il-Mamasita as a separate clan: the others give it as a sub-clan of Il-Molelian. Merker and Fosbrooke further group the clans as (1) those of Enk-aji l-Maasae, "the home of the Masai," Il-Aiser, I-Lukumai, Il-Molelian, Il-Tarosero, Il-Mokesen, and Il-Mamasita; and (2) those of Il-Meŋana, which are Il-Aitayok and Il-Marumae. Fosbrooke has yet another grouping, this time by cattle-colour: I. Il-oo-rok-kiteŋ, "the black ox," or Right Hand, comprising the Il-Aiser and I-Lukumai; II. Il-oo-do-moŋi, "the red oxen," or Left Hand, comprising the Il-Molelian, Il-Tarosero, Il-Mokesen, and Il-Mamasita; and III. Il-Aitayok, attached to the Right Hand, and comprising the Il-Aitayok and Il-Marumae.[29] It is to be emphasized that there is a constant dualism in the structure of Masai groups, largely expressed in terms of cattle-colour. It is found not only in an antagonistic setting, as when cattle are divided after a raid, but also in the sections into which a tribe may be divided. Thus, the Il-Wuasin-kishu were divided into Il-wuasin-kishu oo-rook, "the black striped cattle," and Il-wuasin-kishu oo-nyokio, "the red striped cattle"; and the Sambur into Il-oo-rook-kishu, "people of the black cattle," and Il-oo-ibor-kishu, "people of the white cattle."

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[27] He thus confirms Merker's statement (pp. 16, 46–7) that the main clan was the exogamous unit.

[28] Spelling brought into uniformity with the Tucker system; uncertain spellings in [ ].

[29] Hollis noted that when all clans combined in a raid, the Il-Aiser and Il-Meŋana formed the Il-oo-do-kishu, and the Il-Mokesen and Il-Molelian the Il-oo-rook-kishu.

13:Huntingford E-4 (no date) 1953 **FL12 Masai FL12**

POLITICAL STRUCTURE

Land Divisions and Authorities

The basic unit of a tribe, *ol-oho*, is the *sirit* or warrior company in its *manyata*, 631 for it represents a district from which a given number of fighting men is drawn; and within this district are also the knals, *enk-aŋ*, of the elders. The formation of an *enk-aŋ* varies. It may contain a group of men who continue as elders the association which they began as warriors in the *manyata*; or it may be a casual grouping which can break up and re-group; and it may contain anything from one to 10 gates. Within [623] the *enk-aŋ* a rudimentary council seems to exist with one of the elders at its head; it may be no more than the heads of families sitting together and talking. Such as it is, it corresponds to some extent to the Nandi *kokuet*, though its powers and sphere are smaller. But it differs also in an important respect. All the inhabitants [624] of a Nandi parish, including the warriors, come under the jurisdiction of the *kokuet*, whereas in the Masai system the local warrior company has its own authority, the *ol-aiguenani*, who is responsible for the maintenance of both military discipline and "civil law" within his company; and his warriors appear to be independent of the elders' councils. When the age-set has passed out of the warrior stage, the *ol-aiguenani* remains its authority. A number of *sirit*-districts forms the larger unit, *ol-osho*, which English writers call the section or division, the latter being the word used by Sandford. Each of these *l-oshon* has a council of elders which corresponds in some respects to the Nandi *poroiet* council; and, as will be seen from p. 11 above, the *il-oshon* are associated either in loose confederacies with a group-name, like Il-Purko, Il-Damat, and Il-Keek-onyokie, which together form the Il-Kinopop, or in distinct "tribes" like Il-Aikipiak, Sambur. The organization of the Sambur [184] seems to have developed on slightly different lines from the rest of the Masai.[29] The *enk-aŋ* is the homestead of one elder and his wives and children; a number of such homesteads forms a local group with a council of elders, and the total number of local groups is divided among eight sections called *il-mareita* (sing. *ol-marei*), each with a council made up of the leaders of the component group-councils. These *il-mareita* are divided into two large sections with "cattle-names": the Il-oo-rook-kishu, "the black cattle," contains the *il-mareita* of Lo-l-pusin-kishu, Lo-l-ŋuesi, Ol-masila, and Nyaparai; and the Il-oo-ibor-kishu, "the white cattle," contains the sections called Il-oo-rook-kishu, Lo-l-kumai, Lo-l-musii, and Lo-ŋeli.

The most important figure in Masai organization is the *ol-aiguenani*, whose duties 624 in the past were to make the practical arrangements for war, to control the distribution of the loot, to settle disputes when appealed to, to lead his men in war, and to maintain liaison between his company and the laibon on the one hand, and between his company and other companies on the other. But he could resign if displeased with his men, who in turn could dismiss him if not satisfied with his actions. Now that there is no more organized warfare, the duties of the *ol-aiguenani* are mainly confined to the suppression of raiding, in which his effectiveness depends on his character, influence, and disposition; and to settling disputes, in which he is assisted [623] by the elders of the district. Thus a council system with an elected leader has developed out of the older structure in which the *e-manyata* and *enk-aŋ* were semi-independent bodies. As among the Nandi, it is the personality of the *ol-aiguenani* and the force of public opinion that compel obedience to him. But the whole Masai system [171] is less clear-cut than even that of the Nandi, in spite of the apparent definiteness of the *ol-aiguenani*; though in certain respects he is analogous to the Aba Boku or age-set ruler of the Galla, who is the tribal ruler for a period of eight years.

The Laibon

The laibon, a word anglicized from *ol-oiboni*, pl. *il-oibonok*, and derived from 791 *a-ibon*, "to make 'medicine,'" is a ritual expert who practises divination and rain-making, cures illness, provides charms, and foretells the future. Fosbrooke divides

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[29] Information from the Rev. Charles Richmond of the B.C.M.S.

791 the laibons into three categories: (1) the private practitioner, who works in a small way as a diviner and doctor among a limited circle of clients; (2) the private practitioner who has gained a wider reputation and is consulted by several districts, and includes rain-making among his activities; and (3) the senior laibons, of whom there is one to each tribal group; these all belong to the In-Kidoŋi sub-clan of the Il-Aiser clan, and the different tribal laibons were all fellow-clansmen, if not actually related. Thus, in addition to the laibons of the Kaputie at Ngong (now living among the Loitai), the Kisonko, Il-Aikipiak, Il-Wuasin-kishu and Sambur also had their own; though it is possible that the Ngong laibon had a higher standing throughout Masailand than the others. In pre-European days the functions of a head laibon were[31] (1) to sanction war and to provide protective medicine for those taking part in it; (2) to authorize the ceremonies connected with the age-sets and circumcision; (3) to ensure the fertility and well-being of his people; (4) to make rain. In the exercise of these duties he is both an intermediary between man and the other world, and a mystical focus for tribal activities. Many laibons also practise witchcraft (as defined above, p. 39). But the laibon is not a chief, and his authority depends on his mystical powers.

War Organization

721 When the warriors of a *sirit* wanted to raid, they approached their *ol-aiguenani*, 624 who planned the attack and arranged for the co-operation of other companies if a big raid (*ol-orora*) was intended. The *il-aiguenak* concerned then went to the laibon to get his sanction and protective war medicine. Before agreeing, however, the laibon 726 consulted the omens to see if the circumstances were propitious; and having done so, he gave his consent, sometimes in song after getting drunk. The warriors then went to their *il-puli* and feasted on meat to prepare them for the raid; patrols were also sent out, and when all was ready the party set out by the shortest route to their destination. Raids were made on most of the tribes round them, and extended to the coast, the Nyika being a frequent objective; Thomson was told that a Masai 727 patrol was once seen in Mombasa itself. On their return, the raided cattle were divided. First, a number were set aside for the laibon; then some were given to those who had distinguished themselves; the rest were divided among the warriors, who gave one or two to their lovers in the *manyata*, but handed the rest of their shares to their families. If there were not enough cattle to divide fairly, the warriors separated into two groups, *il-oo-rok-kiteŋ* and *il-oo-do-moŋi*, "the black ox" and "the red oxen," and fought for the spoil. Small raids, *ol-wuampa*, carried out locally by one *sirit*, were not referred to the laibon, who received no share of the spoil.

726 Wars between Masai tribal groups were frequent, and formed one of the factors in the disintegration of the Kenya Masai at the end of the 19th century. In such 578 wars, large numbers of men were collected in camps, such as Thomson saw in 1883 near Elmenteita, where two large collections of warriors (he put the number at about 3,000 on each side) were camped a short distance from each other, one camp being that of the Kaputie, the other of the Il-Aikipiak. A detachment of picked men from each side would come out and fight a pitched battle, cheered on by their women-folk, the winning side taking the cattle of the vanquished. The basis of military discipline 701 was pride, strengthened by fear and respect of the laibon, and fear of public disapproval. The Masai also had some idea of drill and of acting in unison. Gorged [714] with meat, and in the panoply of ostrich-feather head-dress, cape, gleaming spear, shield, sword, club, painted face and leg ornaments, the Masai warrior felt himself more than a match for anyone.

727 Prisoners were not often taken, though sometimes a man would capture a woman whom he would make his wife, or a child whom he would adopt. Men were killed, 728 women seldom. Peace was made by a formal ceremony at which nursing mothers

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[31] Fosbrooke, pp. 15-17.

from each side suckled each other's babies. Peace was then kept till it suited one 728
side to break it. With Bantu tribes the Masai sometimes made mock blood-brotherhood [608
with intent to deceive, for they have no blood-brotherhood of their own. As
among the Nandi, grass is a sign of peace, and a handful of grass constitutes a plea 648]
for mercy recognized by the Masai and those whom they count as more or less their
equals, the *Il-magati* or "enemies," such as other pastoralists, but not *Il-meek*, the [186]
Bantu agricultural tribes.

Legal Sanctions

The Masai legal system seems to be less organized than that of the Nandi, and 671
to depend even more on the force of public opinion than on the position and status
of the council leader. It appears that only in cases of homicide is there anything [626]
like a regular procedure. The Masai distinguish between intentional and accidental
homicide, the difference being that for the latter there is no blood feud and the 682
amount of compensation is smaller. The number of blood-cattle paid as compensation, 681
in-kishu oo-l-oikop, "murder cattle," varies, but may be as high as two to
three hundred for a man; Hollis says 50 for a boy, and Merker 19 head of cattle and 627
19 goats and sheep for a woman. Fosbrooke gives the figures as 49 for a circumcised
man, and 29 for a woman or uncircumcised man. The Il-Arusa are recognized as a
group which pays and receives blood-cattle. The murder may be avenged by the dead
person's brothers who may try to kill the murderer; and if compensation is not paid,
the resulting feud may involve all agnatic kinsmen on both sides. It is not clear
whether killing of the murderer makes the avengers also liable to compensation. If
the victim belongs to the same sub-clan as the murderer, no compensation is payable. [614
If they belong to different sub-clans of the same clan, or to different clans, 672]
all members of the murderer's sub-clan contribute, and the cattle are divided among
the members of the victim's sub-clan after his senior brother has received half the
stock. When a settlement has been made, peace is made between the families concerned
by an exchange of garments. Maguire gives details of three methods of
dealing with cases of murder. (1) The relatives of the victim take all the murderer's
cattle; they hold a council and, after giving a few cattle to certain elders and old
women, the bell-oxen, herd-leaders, and cows near calving are returned to the
owner; the rest they divide among themselves. (2) If action is not taken at once,
the relatives of the murderer send a stick to the relatives of the victim, the acceptance
of which implies an agreement to meet and settle the matter, and compensation is
arranged, the figure named being 40 head of cattle, with nine more added to symbolize
the human body (reckoned by the number of its orifices). (3) Sometimes the relatives
of the victim do not take action for two years or more; they then raid the
murderer's kraal by night and demand the number they want. For killing a smith,
ol-kunoni, no compensation was payable, nor was there a blood feud. If a smith
killed a Masai, several warriors set out and killed several smiths. Theft (except of 685
cattle) is apparently considered of little account: "if a Masai steals milk or meat or
other small things, he is not fined. Grown-up people rarely steal," says Hollis. For
cattle thefts, the thieves when caught were fined, seven head from each man
concerned.

The general principle that a man is entitled to compensation for a wrong 681
suffered is recognized by all Masai; and this recognition is extended to "foreigners"
like Dorobo, provided the people concerned are well known to each other. On being 695
accused, a man may submit to an oath, *ol-mumai*. In some cases a diviner of the
type called *ol-goiatiki* by Merker is employed to find a guilty person. The whole
subject of Masai legal institutions needs detailed investigation.

Modern Administration

The Masai political structure has proved even more difficult of adaptation than 631
that of the Nandi, since it lacked the clear-cut *poroniet* divisions of the latter. Up to 648
1918 the chief laibon in Kenya was accepted by the Administration as a paramount

631 chief; but in that year it was recognized that he was in fact no such thing, and the native administration was reconstructed with 14 Native Councils, one for each 648 division (Il-Purko, Il-Damat, etc.), to replace the original council of the *ol-osho*. These Councils were composed of *il-aiguenak*, elders, and senior warriors; and the presidents of each formed a Central Masai Council which met twice a year. Under the Councils were 46 headmen, some of them *il-aiguenak*. The Reserve was divided into nine locations, the numbers of headmen varying according to the population of the locations. In 1930 these Councils were replaced by a Native Tribunal and an Appeal Tribunal in each of the two administrative districts, Narok and Kajiado, into which the Reserve was then divided. The headmen were divided into two grades, headmen (styled chiefs) and sub-headmen.

In Tanganyika, the laibon was at first regarded as the head of the Kisonko; but since this recognition proved unsatisfactory to the people themselves, a Masai Council was formed as Native Authority, consisting of headmen and elders, but possessing only advisory powers. Later, a local council was set up in each area with representatives of age-sets and clans on it; representatives of each local council sit on the Masai Council. There are 41 paid headmen.

SOURCES: Krapf, 1854; Thomson, 1885; Hollis, 1905; Merker, 1910; Whitehouse, 1933; Fosbrooke, 1948, and personal communication; Hailey, 1950.

MAIN CULTURAL FEATURES

CRAFTS

Housing

The Masai hut, *enk-aji*, pl. *ink-ajijik*, is a low structure with a flat or flattish 342 roof. It is made of a framework of poles which are bent over and tied together. 361 The interstices are filled with grass or brushwood, and the whole, including the top, is plastered over with mud and cow-dung. In wet weather hides are laid on top to keep out the rain. Huts are not isolated, but are grouped together in kraals. (See above, p. 107.) The huts of the agricultural Il-Tiamus have thatched roofs of the normal East African pattern (p. 111). A temporary skin hut called *ol-gobor* is used for a temporary halt where pasture is poor.

Dress and Ornaments (Traditional)

714 Warriors wear a small calf- or goat-skin cape tied over one shoulder, and a small back apron of skin fastened to the belt. Their battle-dress consists of a head-dress of ostrich feathers or of lion-skin, a cape of vultures' feathers, a cap made of a goat's bladder, a calf-skin garment, leg-ornaments of monkey-skin, and a piece [301] of goat-skin fastened to the belt. The distinctive warrior's ornament is the horn arm-clamp called *e-rrap*, which has two points sticking upwards and is worn on the upper arm. Warriors also wear ear ornaments, necklaces, bracelets, and leg-bells. A type of garment called *en-toros* is worn by warriors on certain occasions: Hollis says when going on a raid after electing an *ol-aunoni* (*ol-otuno*); John Tombo ole 291 Mbaei, when they go on a raid after making a vow to conquer or die. Elders wear skin garments fastened over one shoulder; rich elders wear ivory arm-rings. Boys [556 wear a sheepskin.

301] Married women wear a skin cape and a skin skirt held in place by a broad belt. They wear coils of iron wire on the arms and legs, often on both the upper and 291 lower arm, and from knee to ankle. All married women wear flat discs of coiled 301 iron wire, *i-surutia*, hung by straps from the ear-lobes (like the Nandi *taok*), and some wear wide collars made of coiled iron wire which stand out round the neck, and are about 6 or 8 ins. wide. They also wear a profusion of necklaces and neck ornaments. Girls wear skin garments tied at the shoulder and fastened round the waist with a belt. They also wear coils of iron wire on the arms and legs, and necklaces.

Warriors do their hair in pigtails, *ol-taika;* other people of both sexes shave their 302
heads periodically. In both sexes the ear-lobes are pierced and elongated, and the 304
two lower middle incisor teeth are removed. Cicatrized patterns are often made
on the upper part of the body in both sexes.

Iron-work

Iron is used for weapons (spear and sword of warriors, and arrows of elders), 411
axes, knife-blades, razors, and many of the ornaments of both sexes. The spears
and swords are distinctive of Masai culture and, together with the shield and *e-rrap* [412
arm-clamp, separate the Masai and Nandi culturally from other Nilo-Hamites. Spears 171]
are of three shapes: a small leaf-shaped blade with long neck, long shaft, and
medium butt; the great "shovel-blade" with short neck, long shaft, and medium
butt; and the long-bladed winged spear with short shaft and long butt. The colour of
the short shaft of the winged war-spear is important: senior warriors have black
shafts, others reddish ones, and the demand of junior warriors for the privilege of
black shafts is a significant factor in the tension that arises between senior and
junior warriors. The sword has a long narrow blade and is kept in a red leather
sheath attached to the belt. The winged spear-blade and sword have been borrowed [171]
by the Nandi, Kipsikis, Keyo, Kony and others of the Nandi division, together with
the arm-clamp; the Kikuyu have imitated them.

Other Objects

Clubs are made of wood or rhinoceros horn. Shields are roughly oval, about 411
3 ft. long, and made of buffalo or giraffe hide on a light wooden framework; accord- 714
ing to Merker, the old form of shield was circular and (if the scale of his Fig. 34*b* is
correct) about 1 ft. in diameter. Stools are cut out of a solid block of wood and 352
have three legs. Horns are used for summoning people, but there are no musical 322
instruments or drums. 534

RITUAL AND BELIEFS

Religion

Little has been recorded of Masai religious beliefs, except such obvious facts 771
as the invocation of *Enk-ai* (the Masai word for God, rain, and sky). As to ancestor-
worship, it is generally said that the Masai do not believe in an after-life (said also 774
of the Suk); but the alleged belief that the soul of a laibon or rich man turns into a
snake implies some belief in the survival of the soul. This matter needs careful
investigation; and Merker's statement that each Masai is taken to paradise by his [114]
guardian angel and let in by *Enk-ai* if he has been good is alien to Nilo-Hamitic
thought. *Enk-ai* is recognized as a creator, and is prayed to by both men and 776
women. Some of the prayers recorded include an invocation to both *Enk-ai* and
Mbatiany, the laibon who died *c.* 1890; thus Thomson heard the Il-Aikipiak praying [782
to *Enk-ai* and Mbatiany, and the Nandi war dance after a victory, recorded by Hollis
after Mbatiany's death, contained also an invocation to *Enk-ai* and Mbatiany. The
"minor deity called Neiterkob" which Thomson thought was an earth-spirit,
appears in Krapf's book as the Neiterukob, "the mediator between God and men."
But the Masai word *naiterukop* means no more than "that which began the earth,"
and thus would seem really to apply to *Enk-ai* in his role as creator. *Enk-ai*, god, is
grammatically feminine, and his wife *Ol-apa*, the moon, is grammatically masculine.

Death and Burial

The bodies of most people are put out for the hyenas, to the west of the kraal, 764
and laid on the left side so that the face looks eastward, with the legs drawn up,
the head supported by the left hand, and the right hand across the breast. The

764 provision of new sandals, a stick, and some grass in the hand is a further indication of a belief in an after-life. The bodies of laibons and rich men are buried in shallow graves under stone cairns; anybody passing a cairn is supposed to throw a stone on it. Cairns attributed to the Masai exist in Nandi, where they are said to be the graves of men killed in battle. The name of a dead person is never spoken again by the family.

SOURCES: Hollis, 1905; Merker, 1910; Krapf, 1854; Thomson, 1885.

[pp. 127-139 not processed]

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BIBLIOGRAPHY

ABBREVIATIONS

HMSO = H.M. Stationery Office.
JAI = *Journal of the Anthropological Institute* (later *JRAI*).
JAS = *Journal of the African Society* (later *JRAS*).
JEAUNHS = *Journal of the E. Africa and Uganda Natural History Society.*
JRAI = *Journal of the Royal Anthropological Institute.*
JRAS = *Journal of the Royal African Society.*
RGS = Royal Geographical Society.
TNR = *Tanganyika Notes and Records.*

Admiralty, Naval Intelligence Division.
Handbook of Kenya Colony and the Kenya Protectorate. Undated, but c. 1920.
Useful as a reference book, but to be used with caution in matters of ethnography.

Bader, H. E.
1933. "Memorandum on the Samburu." *Kenya Land Commission, Evidence*, II, pp. 1,697–717.
An able and interesting historical study.

Bagge, S. S.
1904. "The circumcision ceremony among the Naivasha Masai." *JRAI*, XXXIV, pp. 167–9.
A somewhat confused account of the circumcision, but still useful.

Bagshawe, F. J.
1924–6. "The Peoples of the Happy Valley." *JAS*, XXIV, pp. 117–30, on the Hadzapi; pp. 25–33, 219–27, 328–47, on the Sandawe; XXV, pp. 59–74, on the Iraqw.
Not very detailed, but useful in the absence of anything better.

Barton, C., Juxon, T.
1921. "Notes on the Suk tribe of Kenya Colony." *JRAI*, LI, pp. 82–99.
At present a useful supplement to Beech; not always reliable.
1923. "Notes on the Kipsikis or Lumbwa Tribe of Kenya Colony." *JRAI*, LIII, pp. 42–78.
Still useful in parts.

Baumann, O.
1894. *Durch Massailand zur Nilquelle.* Berlin.
Useful in parts for early observations on the Masai.

Beadnell, C. M.
1905. "Circumcision and clitoridectomy as practised by the natives of British East Africa." *Brit. Med. Journ.*, 1905, pp. 964–5.
Details of the operation among the Masai and Nandi.

Beech, M[ervyn] W. H.
1911. *The Suk, their language and folklore.* Oxford.
Rather brief and not always accurate account of ethnography; fuller on language, with good vocabulary.
1920–1. "Sketch of Elgeyo law and custom." *JAS*, XX, pp. 195–203.
The only available account of legal sanctions in this tribe.

Bell, C. R. V.
See Huntingford.

Bleek, Miss D. F.
1931. "The Hadzapi or Watindega of Tanganyika Territory." *Africa*, IV, pp. 273–86.
A useful account, with some linguistic notes.

Braunholtz, H. J.
1921. "A peculiar type of armlet." *Man*, 1921, 27.
Description and distribution of the *c-wrap* type of arm-clamp worn by the Masai.

Chaundy, G. H.
See Totty.

13:Huntingford E-4 (no date) 1953 FL12 Masai FL12

113
114

Cooper, B.
1947. "The Kindiga." *TNR*, No. 27, pp. 8–15.
A short account of Hadzapi life, with some good photographs, by a game ranger.

Dallas, D.
1931. "The sacred tree of Ol Donyesha." *Man*, 1931, 43.
An account of a fig-tree with supposed magical properties.

Dempwolff, O.
1916. *Die Sandawe*. Hamburg.
A detailed account of the Sandawe, with notes on the language and texts; does not always agree with van de Kimmenade.

Dobbs, C. M.
1919. "Diseases of stock in Lumbwa District." *JEAUNHS*, p. 461.
1921. "Lumbwa circumcision ages." *JEAUNHS*, 15, p. 55.
A short account, not very accurate, of the age-sets of the Kipsikis.

Dundas, Hon. K. R.
1908. "Notes on the origin and history of the Dorobo tribes." *Man*, 1908, 76.
A collection of traditions, mostly obtained in Kikuyuland.
1910. "Notes on the tribes inhabiting the Baringo district." *JRAI*, XL, pp. 49–72.
Contains some notes on the Keyo and Suk. Useful, but not entirely reliable.
1913. "The Wawanga and other tribes of the Elgon district." *JRAI*, XLIII, pp. 19–75.
Contains some notes on the Pok and Kony, pp. 60–2.

East African Statistical Department
1950. Census. (1) African population of Kenya Colony and Protectorate, Sept., 1950. (2) African population of Uganda Protectorate, Dec., 1950. (3) African population of Tanganyika Territory, Dec., 1950. [Referred to as *E.A. Census, 1948*, the year in which the census was taken.]
Described as "Geographical and tribal studies from the East African Population Census, 1948."

Erhardt, Rev. J. L.
1857. *Vocabulary of the Enguduk Iloigob*. Ludwigsburg.
A useful vocabulary (bearing in mind its age and the way in which it was collected), with a short account of the people.

Evans-Pritchard, E. E.
1940. "The political structure of the Nandi-speaking peoples of Kenya." *Africa*, XIII, pp. 250–67.
A survey of the literature dealing with the political organisation of the Nandi group.

Fischer, G. A.
1885. *Das Massai-Land*. Hamburg.
A few useful observations on the Masai, their material culture and country; mainly geographical.

Fokken, H.
1917. "Gottesanschauungen und religiose Ueberlieferung der Masai." *Archiv. f. Anthrop.* XV, pp. 237–52.
Refers to the Kisonko of Tanganyika Territory.

Forde, C. Daryll.
1934. *Habitat, Economy, and Society*. London.
Chapter XIV, pp. 287–304, contains a short general account of the Masai. Good as an introduction.

Fosbrooke, H. A.
1948. "An administrative survey of the Masai social system." *TNR*, No. 26, pp. 1–50.
The best account so far published of the political organisation and age-set system of the Masai.

Fox, D. Storrs
1930 (1). "Further notes on the Masai of Kenya Colony." *JRAI*, LX, pp. 447–65.
1930 (2). "Description of Masai shields and spears." *JEAUNHS*, 37, pp. 201–2.
1931. "Notes on marriage customs among the Masai." *JEAUNHS*, 33–43 pp. 183–92.
Contains also some notes on circumcision and age-sets.

113
114
Frazer, Sir James G.
1910. *Totemism and Exogamy*, vol. II. Exogamy and the classificatory system of relationship among the Masai. Pp. 407–17.
A concise account based on Hollis and Merker.

Fuchs, H.
1910. *Sagen, Mythen und Sitten der Masai.* Jena.
A collection of folk-literature.

Gilks, J. L.
See Orr.

Hailey, Lord.
1950. *Native Administration in the British African Territories. HMSO.* Part I. Deals with Nandi and Suk, pp. 138–46; Kipsikis, pp. 147–62; Kenya Masai, pp. 167–77; Tanganyika Masai, pp. 282, 283, 287, 288; Mbale district, pp. 281, 282.

Hamilton-Ross, J. G.
1933. *Kenya Land Commission, Evidence*, Vol. II.
Memorandum on the Keyu, pp. 1,951–70.

Hemsted, C. S.
1923. "Tribal organization of the Nandi." *JEAUNHS*, 18, pp. 3–18.
Rather inaccurate notes.

Hennings, R. O.
1951. *African Morning.* London.
This is not an anthropological book; but it contains the fullest description available of Marakwet irrigation.

Hinde, S. L. and H.
1901. *The Last of the Masai.* London.
Unreliable; nearly half the book deals with wild animals.

Hobley, C. W.
1902. *Eastern Uganda.* London.
Useful, but must be read with caution; has some historical value. Deals with the Nandi, pp. 36–42, 58, 59; Masai, p. 59; Dorobo, pp. 11, 12.
1903 (1). "Anthropological studies in Nandi and Kavirondo." *JAI*, XXXIII, p. 325.
Contains some traditions of Nandi origins.
1903 (2). "Notes concerning the Eldorobo of Mau." *Man*, 1903, 17.
1905. "Further notes on the Eldorobo or Oggiek." *Man*, 1905, 21.
1906. "Notes on the Dorobo people." *Man*, 1906, 64.
This and the previous paper are mainly on language, and are useful as showing that the Kenya Dorobo speak dialects of Nandi.
1910. *Ethnology of A-Kamba and other East African tribes.* Cambridge.
Contains a short chapter on the Masai, somewhat confused.

Hollis, A. C. [Sir Claud]
1905. *The Masai, their language and folklore.* Oxford.
The best book available on the Masai; much of it is in the form of texts with translation; there are also the texts of folk-tales, and a full and reliable grammar.
1905. "Masai ear-ring of stone." *Man*, 1905, 19.
1908. "The religion of the Nandi." *Transactions of the Third International Congress for the History of Religions.* Oxford. I, p. 87.
Absorbed into his book on the Nandi.
1909 (1). *The Nandi, their language and folklore.* Oxford.
A good account of material culture and a number of customs; has little about social and political organisation. Nearly half the book is grammar and vocabulary, both reliable. Both his books are indispensable for a study of the Masai and Nandi languages.
1909 (2). "Some Dorobo beliefs." *Man*, 1909, 101.
Note on a Dorobo rain-maker between Naivasha and the Anglo-German frontier.
1910. "A note on the Masai system of relationship and other matters connected therewith." *JRAI*, XL, pp. 473–82.
The best account of the Masai kinship system.
1943. "The Masai." *JRAS*, XLII, pp. 119–26.
ew of changes in the Masai since the publication of his book in 1905.

Huntingford, G. W. B.

1927. "Miscellaneous records relating to the Nandi and Kony." *JRAI*, LVII, pp. 417–61. 113
Includes notes on diviners, age-sets, marriage, names, texts, and a brief account of the Kony. 114

1929. "Modern Hunters." *JRAI*, LIX, pp. 333–78.
An illustrated account of Dorobo material culture (the bands described in this volume), with a short grammar and vocabulary.

1933 (1). "The Nandi military divisions and their bearing on the land system." *Kenya Land Commission, Evidence*, Vol. II, pp. 2,043–66. Nairobi.
Memorandum presented to the Land Commission in 1932.

1933 (2). "The significance of bride-price, with special reference to the Nandi." *JEAUNHS*, 45–6, p. 51.

1933 (3). Memorandum on a suggested Reserve of land for the Tindiret Dorobo. *Kenya Land Commission, Evidence*, Vol. II, pp. 2,039–43.

1934. "Some aspects of Nandi stock-raising." *JEAUNHS*, 49–50, pp. 220–43.
Notes on Nandi methods of cattle management.

1935. "The Nandi Pororiet." *JRAI*, LXV, pp. 133–43.
A short account, with a Nandi text.

1942. "The social organization of the Dorobo." *African Studies*, I, pp. 183–200.
Short summary of field-work done in 1928–40.

1944. *The Nandi.* (Peoples of Kenya series No. 11.) Nairobi.
A short account of social and political organization.

1950. *Nandi Work and Culture.* London.
A detailed account of economic life, with a chapter on Nandi history and topography, and a discussion of Nandi culture.

1951. "The social institutions of the Dorobo." *Anthropos*, XLVI, pp. 1–48.
Deals with kinship, family life, behaviour, age-sets, the clan, circumcision, marriage, and names.

1953. *The Nandi of Kenya: Tribal control in a pastoral society.* London.

Huntingford, G. W. B., and Bell, C. R. V.

1950. *East African Background.* London.
An introduction to East African ethnography for non-specialists, with sections on Nandi organization, age-sets, and warfare, and an analysis of the Masai age-sets.

James, L.

1939. "The Kenya Masai." *Africa*, XII, pp. 49–73.
An account of the Masai in 1939, and a critical discussion of their administration.

Johnston, H. H. (Sir Harry)

1886. *The Kilimanjaro Expedition.* London.
A useful account of the Masai before the coming of the European administrations.

1902. *The Uganda Protectorate.* London.
Though now largely superseded by other works, this book is still useful (with caution) for certain aspects of East African ethnography. It contains accounts of the Masai, pp. 796–838; Suk, pp. 841–63; Nandi group, including Dorobo, pp. 913–29.

1915. Article "Masai" in Hastings, *Encyclopaedia of Religion and Ethics.* Vol. VIII, pp. 480–3.

Kenya Land Commission

1933. *Evidence*, Vol. III. Nairobi.
This volume contains material relating to the history and land problems of the following peoples: Nandi, pp. 1,948–61, 2,039–60, 2,066–79; Dorobo, pp. 1,868–72, 1,979–86; Keyo, pp. 1,831–47; Kamasya, pp. 1,781–94, 1,830–46, 1,853–62, 1,896–1,901; Suk, pp. 1,722–7, 1,735–45, 1,773–81, 1,829–42; Masai, 1,173–384. [Abbreviated as K.L.C.]

Kenya Land Commission

1933. *Report.* Nairobi.
Contains references to the Nandi, sections 1,030–73; and Kipsikis, sections 1,148–62.

13:Huntingford E-4 (no date) 1953 FL12 Masai FL12

113
114
Krapf, Rev. J. L.
1854. *Vocabulary of the Engutuk Eloikob.* Tubingen.
Apart from its historical interest, the vocabulary is still useful. There is a short account of the Masai on pp. 3-31.
1860. *Travels, Researches, and Missionary Labours during an Eighteen Years' Residence in Eastern Africa.* London.
Krapf was the first European to travel through any part of the Masai sphere of influence.

Lambert, H. E.
1950. *The systems of land tenure in the Kikuyu Land Unit. Part I. History of the tribal occupation of the land.* University of Cape Town.
A useful study, with many references to the Dorobo who occupied the land before the Kikuyu. Short account of the Keritta Dorobo, pp. 67-8.

Leakey, L. S. B.
1930. "Some notes on the Masai of Kenya Colony." *JRAI*, LX, pp. 185-209.
Based on information from Kikuyu-speaking Masai.

Lindblom, K. G.
1921 (1). "Mount Elgons grottor och folk." *Ymer*, p. 139.
Deals with the Kony.
1921 (2). *I vildmark och negerbyar å Mount Elgon och annorstädes i Ostafrika.* Stockholm.
The Nandi-speakers on Mount Elgon.
1924. "Some words of the language spoken by the Elgoni people." *Le Monde Oriental*, XVIII, pp. 46-55.
Contains some brief notes on the people and their religion (Kony).

Macdonald, Lt.-Col. R. L.
1899. "Notes on the ethnography of tribes met with during the progress of the Juba expedition." *JAI*, I, p. 226.

Maguire, R. A. J.
1927-8. "Il-Torobo." *JAS*, XXVII, pp. 127, 249.
An account of the Dorobo of Tanganyika Territory.
1948. "Il-Torobo." *TNR*, June, 1948, pp. 1-28.
Reprint of previous article.
1928. "The Masai penal code." *JAS*, XXVIII, pp. 12-18.
1931. "Masai water trees." *Man*, 1931, 183.
Note on Dallas's paper in *Man*, 1931, 43.

Massam, J. A.
1927. *The Cliff Dwellers of Kenya.* London.
A superficial account of the Keyo.

Merker, M.
1903. "Religion und Tradition der Masai." *Zeit. f. Ethnol.*, XXXV, pp. 733-44.
Absorbed into his *Die Masai*.
1910. *Die Masai: ethnographische Monographie eines ostafrikanischen Semitenvolkes.* Berlin. (1st ed., 1904.)
Valuable for material culture and descriptive accounts of visible features of Masai life; much valueless discussion of Masai racial affinities.

Obst, E.
1913. "Der östliche Abschnitt der grossen ostafrikanischen Störungszone." *Mitt. d. Geogr. Ges. in Hamburg*, XXVII, pp. 163-203.
Has some material on the Sandawe.
1915. "Das abflusslose Rumpfschollenland im nordöstlichen Deutsch-Ostafrika." *Mitt. d. Geogr. Ges. in Hamburg*, XXIX.
Has some material on the Sandawe.

Orchardson, Ian Q.
1919. "Supernatural beliefs of the Lumbwa." *JEAUNHS*, pp. 417-29.
Deals with the religion of the Kipsikis; useful.
1933 (1). "Religious beliefs among the Kipsigis." *East African Standard*, 12 Aug., 1933.
Report of a lecture to the East Africa and Uganda Natural History Society.
1933 (2). "Marriage customs of the Kipsigis." *JEAUNHS*, 45-6, pp. 99-112.

Orchardson, Ian Q.—*continued.*
1933. "Religious beliefs and practices of the Kipsigis." *JEAUNHS*, 47–8, pp. 154–62. 113
1935. "The African explains witchcraft: II. Kipsigis." *Africa*, VIII, pp. 309–15. 114
A useful collection of statements by three Kipsikis, with comments. The author has known the Kipsikis well for many years.
1936. "Future development of the Kipsigis, with special reference to land tenure." *JEAUNHS*, 5–6, pp. 200–10.
Some useful notes on land tenure.

Orr, J. B., and Gilks, J. L.
Studies of nutrition: the physique and health of two African tribes. HMSO. London.
A valuable description of the diet of the Masai and Kikuyu.

Pagé-Jones, F. H.
1948. "Water in Masailand." *TNR*, No. 26, pp. 51–9.
An account of the water supplies in the Masai district of Tanganyika, their ownership, the related settlement pattern, and seasonal migrations determined by them.

Peristiany, J. G.
1939. *The social institutions of the Kipsigis.* London.
The first full account of the Kipsikis; useful for material culture and legal processes.
1949. *La vie et le droit coutumier des Kipsigis du Kenya.* Ét. soc. et ethnol. jurid. sous dir. R. Maunier, XXVIII. Paris.
1951. "The age-set system of the pastoral Pokot." *Africa*, XXI, pp. 188–206, 279–302.
A full and detailed account of the *sapana* and post-*sapana* ceremonies among the pastoral Suk.

Phillips, A.
1945. *Report on Native Tribunals.* Nairobi.
Nandi, pp. 109–11; Masai, pp. 141–4.

Radcliffe-Brown, A. R.
1950. *African Systems of Kinship and Marriage.* London.
Good analysis of the Masai kinship system, based on Hollis, pp. 18–22.

Reche, O.
1914. *Zur Ethnographie des abflusslosen Gebietes Deutsch-Ostafrikas.* Hamburg.
Useful account of material culture of "Kindiga" (Hadzapi), pp. 4–22; Sandawe, pp. 24–31; "Fiomi" (Gorowa), pp. 103–7; Burungi, pp. 107–10; together with material on the Bantu neighbours of these peoples. Good for comparative study.

Ried, H. A.
1915. *Zur Anthropologie des abflusslosen Rumpfschollenlandes im nordöstlichen Deutsch-Ostafrika.* Hamburg.
Physical anthropology; has some material on the Hadzapi.

Roscoe, Rev. J.
1924. *The Bagesu.* Cambridge.
Chapter VIII deals unconvincingly with the Sapei, who are referred to as "Basabei."

Routledge, W. S. and K.
1910. *With a prehistoric people: the Akikuyu of British East Africa.* London.
Appendix II (pp. 344–9) contains a short account of the Masai; not very useful.

Sandford, G. R.
1919. *An administrative and political history of the Masai Reserve.* London.
A useful and valuable study, with good maps.

Seligman, B. Z.
1917. "The relationship systems of the Nandi, Masai, and Thonga." *Man*, 1917, 46.
A short comparative study, based on Hollis's material for the Nandi and Masai.

Shelford, F.
1910. "Notes on the Masai." *JAS*, IX, pp. 267–9.
Short account of a journey through Masailand.

Stigand, C. H.
1913. *The Land of Zinj.* London.
Sketchy account of the Masai on pp. 204–32.

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113
114
Stoneham, Lt.-Col. H. F.
1933. Memorandum on the Dorobo. *Kenya Land Commission, Evidence*, Vol. II, pp. 2,061–2.

Thomson, J.
1884. "Through the Masai country to Victoria Nyanza." *Proc. RGS.*, VI, pp. 690–712.
1885. *Through Masai Land.* London.
Thomson was the first European to traverse Masailand, and his book has an historical value. Besides many details of great interest on the Masai, he has a little to say about the Dorobo (chap. X), and the Kony and Suk (chap. XII). Indispensable in a study of the Masai.

Totty, L. H., and Chaundy, G. H.
1944. *The people and district of West Suk.* (Peoples of Kenya series, No. 17.) Nairobi.

Trevor, J. C.
1947. "The physical characters of the Sandawe." *JRAI*, LXXVII, pp. 61–78.
Though mainly on physical anthropology, there are some notes on ethnography.

Van de Kimmenade, Rev. M.
1936. "Les Sandawe." *Anthropos*, XXXI, pp. 395–416.
An account of social organisation and religion; of some value.

Von Höhnel, L.
1894. *Discovery of Lakes Rudolf and Stefanie* (English translation). London.
The narrative of Count Teleki's hunting and exploring expedition in East Africa in 1887–8. Very useful for details of tribal distribution, and other items of ethnographical interest.

Von Luschan, F.
1898. "Beiträge zur Ethnographie des abflusslosen Gebietes von Deutsch-Ostafrika" in Werther, q.v.

Ward, C. E.
1926. "Sunworship amongst the Kipsikis or Lumbwa tribe." *JEAUNHS*, pp. 26, 27.
Description of a ceremony held in the month of May.

Weiss, Max.
1910. *Die Völkerstämme im Norden Deutsch-Ostafrikas.* Berlin.
Good photographs of Masai and Dorobo of Masailand.

Werther, W.
1898. *Die mittleren Hochländer des nördlichen Deutsch-Ostafrika.* Berlin.

Whitehouse, L. E.
1933. "Masai Social Customs." *JEAUNHS*, 47–8, pp. 146–52.
A valuable but somewhat confused account of the formation of age-sets; many misprints in the Masai words used.

Woodhouse, C. W.
1913. "People of the South-east slopes of Mount Elgon." *JEAUNHS*, 8, pp. 16–26.
Notes on the divisions and organization of the Kony.

796 Masai FL12
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[Further information on the ceremonies and related activities leading to formation of age-sets may be found in category 561.]

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STUDIES OF NUTRITION

THE PHYSIQUE AND HEALTH OF TWO AFRICAN TRIBES

By J. B. ORR and J. L. GILKS
(for the Dietetics Committee of
the Economic Advisory Council)

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PREFACE.

KM 121 The Medical Research Council are glad to publish in this series the following report by Dr. J. B. Orr, Director of the Rowett Research Institute at Aberdeen, and Dr. J. L. Gilks, Director of Medical and Sanitary Services in Kenya Colony and Protectorate. The report deals with an investigation into the physique and health of two African tribes, the Masai and the Akikuyu. The information brought forward is of great interest in relation both to general scientific questions of nutrition and to particular problems presented by the native races inhabiting British Colonies in the tropics.

KM 122 The investigation described was made for the Dietetics Committee of the Committee of Civil Research (now the Economic Advisory Council), and was financed by grants made by the Empire Marketing Board. Publication by the Medical Research Council was recommended by the Committee, in order that the information contained in the report might be made available most effectively to those concerned.

KM 128 The account of the investigations is here introduced by what is the Sixth Report of the Dietetics Committee. This document gives a history of the work and a survey of the data obtained. Everything of scientific importance contained in the five unpublished interim reports that preceded it, as also in certain technical papers by the several investigators (*see* p. 8), is included in the present publication.

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The Physique and Health of Two African Tribes.

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By J. B. ORR, D.S.O., M.C., M.D., D.Sc. (*Director, Rowett Research Institute, Aberdeen*), and J. L. GILKS, F.R.C.S.(Ed.) (*Director, Medical and Sanitary Services, Kenya Colony and Protectorate*).

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I.—INTRODUCTION: THE PHYSIQUE AND HEALTH OF TWO AFRICAN TRIBES.

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The Public Health organisation of modern civilised countries, with its system of collecting and analysing data on the incidence of disease, has no parallel among many African native races. Such information as we have regarding these races is derived from records of sickness in native labour on mines or estates, the occasional observations of medical missionaries, and the reports of district medical officers. During the past few years, the expansion of the public medical services in those areas, with the establishment of native hospitals, has added to our information through the official records. But so far these services come in contact with only a small part of the total native population, and we are still left in considerable ignorance as to the general incidence of disease, especially within the native reserves.

The information we have gives the impression that the physique of tropical native races is in no way superior, and is frequently much inferior to that in civilised communities, and that, in addition to tropical diseases such as malaria and sleeping sickness, other diseases, which are common to all parts of the world, are as prevalent among native races as among civilised peoples. The following records may be quoted as giving a rough picture of the physique and susceptibility to disease of the East African native.

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The physique of the typical male Kikuyu may be judged from recruiting statistics (Tate, 1917–18). Of the 16,754 men of one district of the Reserve who were called up during 1917 for enrolment in the Carrier Corps, 10,912 were immediately rejected on medical grounds. Following the march of one hundred miles to the depôt at Nairobi, a further 17 per cent. were rejected as physically unfit.

Records of the incidence of disease in native labour on railway construction gives a striking picture of the morbidity amongst the adult male population at the period of life of greatest vigour. The records are the more significant that these labour gangs do not constitute a random sample of the population; they have already been subjected to medical examination with elimination of the obviously unfit. Of a labour strength of 14,440 employed on the construction of the Uasin Gishu Railway (Fisher, 1923) in 1923, the death rate was 35·4 per 1,000, and the admissions to hospital during the year were 5,331. Improvement of the hygienic conditions and a change in the diet in the direction of making it more varied and more like that consumed by Europeans, by decreasing the amount of maize and increasing the legumes, green vegetables and meat, was followed by a fall in the death rate. In 1924 (Boedeker) it was 10·8 per 1,000. But even this lower rate is high for selected men medically examined before being accepted for work. In the British

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army, the body of men in this country most comparable to African contract labour, the death rate in peace time is only about 2 per 1,000.

Observations on general morbidity of the population of one of the coast reserves have recently been made in the course of an investigation on ankylostomiasis (Annual Medical Report, Kenya Colony, 1927). The following figures show the number of cases of different diseases noted in a " trial survey," including examination of 657 persons, of whom 525 were adults and 132 children :—

Nourishment unsatisfactory	425
Anæmia	570
Pyorrhœa	406
Hæmic murmurs	546
Enlarged spleen (adults)	225
Enlarged spleen (children)	98
Tuberculosis	159
Bilharzia	38
Yaws	446
Syphilis	2
Gonorrhœa	5

Examination of the fæces of 436 of the above was carried out. The results showed :—

Ankylostomes present	344
Ascarides	66
Trichuris	26
Strongyloides	5
Tænia	10
Oxyuris	2

An examination of hospital returns shows the major diseases which are most prevalent. These are pulmonary diseases, ulcers and intestinal diseases. Almost 50 per cent. of deaths in hospitals are due to diseases of the respiratory system, of which pneumonia is probably the most serious, appearing for several years as the chief cause of adult mortality in both Nairobi and Mombasa. Tuberculosis is common, and usually appears as second on the list of causes of adult mortality in the townships. In the reserves, tuberculosis appears to be noted more frequently than it was, but it is not certain whether the disease is increasing or whether the apparent increase is due to extension of the " hospital habit " among the population.

Ulcers of the leg are common and account for much sickness. The cases encountered in the native reserves are frequently of a most severe type, and it is not uncommon to find that the ulcerative process has extended to the bone with resulting osteo-myelitis and the formation of extensive sequestra. Amongst contract labour they are responsible for more loss of time than any other condition. This is shown by the following sickness record for the months March to September, 1924, amongst a labour strength averaging 5,800 on the Thika-Nyeri Railway (Fisher, 1924).

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Analysis of 1,187 *Cases of Illness.*

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No. of cases.	Disease.	Total No. of days in hospital.	Average No. of days per case.
439	Pulmonary	3,043	6·93
382	Diarrhœa and dysentery	2,196	5·57
180	Fever	917	5·39
186	Ulcer	4,054	21·80

This table illustrates the frequency with which intestinal disturbances occur among contract labour. Dysentery and diarrhœa also occur frequently in the reserves. The cause of the dysentery is not clear. It is not commonly associated with the presence of the Entamoeba histolytica or of typical Shiga or Flexner bacilli, and it has been noted clinically that a good dietary has a considerable effect in reducing mortality from this cause.

No vital statistics are available. It is believed, however, from observations made in limited areas, that the infantile death rate in the native reserves amounts to between 400 and 500 per 1,000. Records of the cause of death from the native hospitals in Nairobi and Mombasa show that nearly 50 per cent. of infantile deaths are due to pneumonia and broncho-pneumonia.

No information of any kind exists as to the longevity of these tribes. It is, however, a matter of common observation that the women age very early.

Thus, such statistical data as we have bear out the impression of medical officers, with experience of work in the native reserves, that in many tribes the physique of the natives is poor, and the incidence of disease, in addition to malaria, yaws, sleeping sickness and such other diseases as are regarded as being peculiar to the tropics, is high. The poor physique, considered together with the high incidence of pulmonary and intestinal conditions, resistance to which appears to be lowered by deficiencies in the diet (Orr, 1924, 1930), suggests that undernutrition, or malnutrition, or more probably both, may occur to a marked degree amongst native tribes.

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The investigation dealt with in this report was undertaken with the primary object of obtaining more information regarding the dietary customs and incidence of disease in natives in the reserves and on the adequacy of the diets in use in native hospitals and prisons. The main lines of the investigation were as follows :—

(1) A survey of the dietary customs and disease incidence in two tribes, viz., the Akikuyu, a vegetarian tribe, and the Masai, who are largely carnivorous.

(2) A detailed clinical and physiological study of youths and men on native hospital and prison diets.

(3) A special study of the etiology of tropical ulcer.

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K M 125 The information collected directly was supplemented by the replies to two questionnaires issued by the Medical Department to district medical officers, medical missionaries, chiefs of tribes and others interested in the investigation. One questionnaire dealt with the dietary customs of natives and the other with the incidence and etiology of ulcers.

II.—FIELD WORK.

(a) Dietary Customs and Incidence of Disease in the Kikuyu and Masai Reserves.

K M 114 Dr. J. W. Foster was sent out from the Rowett Research Institute to carry out this part of the investigation, and Dr. J. C. J. Callanan, of the Medical Service in Kenya, was specially detailed to work with him for the first five months.

K M 121 262 The two reserves chosen for the investigation were the Kikuyu and Masai, the choice being made on account of the fact that the reserves adjoin while the dietary customs of the tribes are very different, the Akikuyu* being almost exclusively vegetarian and the Masai chiefly carnivorous.

K M 126 [114] The two Reserve areas were visited alternately during a period of over a year and a half, each trip occupying two or three months. Samples of all foodstuffs in common use were collected and despatched to the Rowett Institute for analysis. The samples consisted of articles of diet in the raw state, cooked foods, edible earths, salt substitutes, and natural mineral waters used in cooking.

K M 125 A physical examination was made of 6,349 Kikuyu and 1,546 Masai† adult natives of both sexes and all ages. The examination was made under eighteen heads, including stature, weight, chest, abdomen and calf measurements; presence of anæmia; condition of teeth and gums; general physical and muscular development; strength as indicated by the dynamometer; presence of hernia, splenomegaly; ulcers.

A similar examination was made of 2,500 Kikuyu and 254 Masai children. The special object of this examination was to compare the tribal incidence, during the growth period, of osseous deformities, dental caries, periodontitis, anæmia, and general signs of malnutrition.

The subjects examined for physical condition were taken at random from the healthy section of the community in all parts of the Reserves. Great care was taken to exclude any sick native who presented himself. Apart from this, no selection was made, and the records may be taken as representatives of the average native of the Reserves.

An estimation was made of the diseases prevailing in the two tribes. Hospital returns were analysed, but, as it became apparent that, for

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K [101] * The prefix "A" in Akikuyu has a collective sense, the term "Akikuyu" referring to the tribe as a whole, while the term "Kikuyu" has only an adjectival significance.

K [161] † It should be noted that the estimated populations of the Kikuyu and Masai Reserves at the end of 1929 were respectively 795,934 and 48,547.

many reasons, this did not give a complete picture of tribal morbidity, K M 125
the plan was also adopted of travelling with a medical outfit
and offering free treatment to sick natives. By this means, many K M
thousands of natives were seen who, on account of such considerations [123]
as the distance involved, or inherent shyness, would never
have appeared at a hospital.

(i) *The Akikuyu.* K

The Akikuyu are a Bantu tribe, numbering about ¾ of a million, 101
who occupy part of the highlands of Kenya between the equator 161
and 1 deg. south. They are agriculturists and live on a diet which K
is chiefly vegetarian. Beef may be almost entirely discounted from 262
the diet ; game, fish, birds and eggs are ignored, and the eating of
goats and sheep is almost confined to the old men. A goat or ram K
is slaughtered only at a marriage or other feast, or to remove "thahu" [783]
(ceremonial uncleanness). On such an occasion, the old men eat
the entire animal with the exception of one leg and the viscera,
which are divided among the women and children. Meat cannot
therefore be regarded as forming a regular part of the dietary.
The amount eaten by the women and children must be insignificant. K
It should be noted, however, that although so little meat is eaten [238]
the natives possess large herds of goats. These are used mainly as [436]
currency, instead of as a source of supply of milk and meat.

There are very few cattle in this Reserve and those are in the K 233
hands of a wealthy minority. The milk yield of native cows, under 234
native management, is very low. In most cases it probably does 556
not exceed 100 gallons per annum. Hence, very little cow's milk
is available.

The great bulk of the Kikuyu diet consists of cereals, tubers, K 262
plantains, legumes and green leaves. The males show a preference
for cereals and tubers, 60 per cent. of their diet consisting of maize
or millet, and sweet potatoes accounting for a further 25 per cent.
The women also subsist chiefly on these articles, but add more liberal
quantities of legumes and plantains and have a virtual monopoly of
the green leaves.

In addition to natural foodstuffs, a common article of diet, K 261
especially among the women, is the earth from salt licks. In all the 443
native markets these edible earths are displayed for sale. Another 263
common practice throughout the Kikuyu Reserve is the preparation
of a salt substitute by the burning of swamp plants. During recent
times Magadi soda has largely replaced these salt substitutes. K
Evidence was obtained that the consumption of edible earths and 261
plant ashes is more common amongst the women than the men. 263
It appears that the practice is for young children of both sexes to be K
given food containing these salt substitutes up to about the age of 262
5 years. Afterwards the custom appears to be confined to the K
females, and the young boys and men get little, if any. In addition 271
to these salt substitutes, water from special springs is highly esteemed
for human consumption and is used in cooking.

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Kenya FL1

M (ii) *The Masai.*

10 233 The Masai are a pastoral tribe whose sole occupation is the tending of large herds of cattle, sheep and goats. It has been estimated that they have about 25 head of cattle, and twice as many sheep and goats, per head of the population.

M 262 261 [263] The staple articles of diet are meat, milk, and blood. The blood is drawn from the living animal by puncture of the jugular vein with an arrow. Various roots and barks are used to make infusions which are used either with boiled meat or with milk. The men, while in the "moran," or warrior class, subsist practically entirely on these articles of diet. The rest of the population, in addition to these four items, which form the main part of their food, eat also some bananas, beans, millet, arrowroot, maize, sugar and honey, as these are available. The use of maize, which was introduced only a few years ago, is increasing.
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For the greater part of the year there is no scarcity of meat, blood and milk, but in periods of severe drought, when, in spite of the large herds, the milk supply is inadequate, the consumption of these vegetable foods is increased, and even the "moran" may be compelled to supplement their meat and milk diet.

M [484] [843] [146] Berries are eaten by the warriors when on safari, *i.e.*, on hunting or fighting expeditions. It appears also to be customary to send the pregnant women into the bush to eat berries. The berries would make an insignificant contribution to the main constituents of the diet, but it is probable that they are of considerable importance as an antiscorbutic addition.

M [184] One section of the tribe, the Loitokitok, have adopted a frankly mixed diet. It is of interest that pica among the Masai is confined to this section, who use edible earths from various sources with their vegetable foods.

(*b*) Chemical Composition of Native Foodstuffs, Edible Earths, and Mineral Waters.

Ka M K 146 The results of the chemical analysis of 153 samples of substances used in the dietary of the two tribes are given in Appendix I. Certain points of interest are discussed below.

(i) *Foodstuffs.*

In the following table a comparison is made between the analyses of the chief Kenya foodstuffs and analyses of similar products grown in other regions, probably in Europe or America, as quoted by Sherman (1926). All the figures are given as grams per 100 grams dry matter.

	Kenya Maize.	*Maize.*
Ca	·005	·011
P	·41	·32
Na	·038	·084
Cl	·05	·058
K	·42	·48

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	Kenya Millet.		
	Red.	*White.*	*Millet.*
Ca	·287	·020	·016
P	·326	·356	·363
Na	·004	·013	·094
Cl	·150	·088	·021
K	·706	·470	·322

	Kenya Potatoes.	*Potatoes.*
Ca	·050	·052
P	·230	·280
Na	·014	·085
Cl	·120	·140
K	2·360	2·030

	Kenya Leaves.	*Cabbage.*	*Spinach.*
Ca	2·66	·57	·83
P	·63	·46	·74
Na	·131	·44	1·93
Cl	·63	·35	·26
K	5·35	4·40	10·13

	Kenya Plantains and Bananas.	*Bananas.*
Ca	·02	·037
P	·14	·119
Na	·045	·240
Cl	·27	·421
K	1·83	1·291

It appears at once that the phosphorus content of the foodstuffs is approximately the same throughout. Potassium tends to be slightly higher in the Kenya foods and is definitely higher in red millet. Chlorine is high in the Kenya leaves and red millet, and approximately the same in the other foods. Calcium is low in maize and bananas, about equal in white millet, but considerably higher in red millet and green leaves. Sodium is low throughout. The high calcium and chlorine content of the Kenya leaves is striking. Indeed, the percentage of calcium in some of the leaves is higher than that previously recorded for any natural foodstuff. Hence, any considerable addition of leaves to a diet of cereals and potatoes or plantains would tend to correct the deficiency of these foods in calcium. In this connection it is interesting to observe that a selective preference for particular leaves appears to exist. From the observations in the field and the replies to the questionnaire, it has been possible to classify the leaves analysed according as they are commonly used by men and women, by women alone, or by women in time of famine only.

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Ca. in grm. per 100 gm. dry matter in leaves used by :—

Leaves.	Men and women.	Leaves.	Women only.	Leaves.	Women in famine.
Mathoroko	3·74	Marenge	1·74	Kalema	2·61
Terere	2·56	Maboco	3·31	Managu	2·43
Togotia	3·48	Ndoma	2·64	Muyuyu	0·85
Hatha	4·52				
Average	3·57		2·56		1·96

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It has been noted, however, that the tendency throughout the reserve is for men to eat much less of the green leaves than the women do. It is stated that in some districts they eat none. A reason given for this, in a reply to the questionnaire from one of the native chiefs, is that " . . . such food prevented them from being swift of foot if defeated in battle by the Masai."

Estimations of manganese were made in some foodstuffs (Appendix I, Table II). The level in white millet and maize was found to be similar to that found in these foods grown elsewhere, but the manganese content of Kenya green leaves was found to be very much higher than that of edible leaves in this country. The following table shows the nature of the differences found (Richards, 1930) :—

Manganese in mgms. per 100 gms. Dry Matter.

Kenya Samples.		*Home-grown Samples.*	
Red millet	40·19	Oatmeal	6·9
White millet	2·55	Barley	2·01
Green leaves	8·93 to 51·31	Cabbage	1·50
Average	30·0	Lettuce	13·30

The manganese content of plant ash used as a salt substitute was also found to be very high, the values for two samples being 418 mg. and 352 mg. per 100 gms.

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(ii) *Salt Substitutes and Mineral Waters.*

The ashes of water plants (Appendix I, Table IV) largely used as salt substitutes by women, especially during pregnancy and lactation, contain significant amounts of calcium and sodium. The average calcium content of seven samples, procured at native markets or in the villages, is 3·4 per cent., and the average sodium content 7·3 per cent. One of the samples analysed stands out from all the others by reason of its high calcium content, which is 10·60 per cent. as compared with values ranging from 1·0 to 1·5 per cent. for the others. This sample was bought at Wandiga's market, and the ash from this market, and that from neighbouring swamps on the Kagumo River, which is probably identical with it, appears to be more in demand than any of the others mentioned in replies to the questionnaire.

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Of the 15 edible earths analysed (Appendix I, Table V), 13 were definitely richer in sodium than ordinary Kenya soils. The sodium content of these 13 earths ranges from 0·24 to 30·15 per cent. Five of these samples were from the Masai Reserve, and four of them contain high percentages of sodium. The best of these with 30·15 per cent. would form a fair substitute for Magadi soda. In the samples from the Kikuyu Reserve, the highest sodium content is 6·35 per cent.

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With regard to the other inorganic constituents, only one of the 13 samples was richer in phosphorus than ordinary Kenya soil. Five of the earths are definitely richer in calcium than soil, ranging from 0·77 to 2·56 per cent. as compared with 0·75 per cent. in soil. Two of these are from an area in the Kikuyu Reserve, and it is interesting to find that they are the most sought after. The source of supply of one of them, viz., Gitirikani earth, which has a calcium content of 1·38 per cent., was at one time in the Masai country. The Kikuyu were then in the habit of making raids and fighting for this salt. They state that their cattle were fatter, bred better, and were more resistant to disease when they had a supply of Gitirikani earth. Similarly in the Masai reserve, the most popular earth is said to be that from Ol Donyorasha, and it has the highest calcium content.

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The two edible earths which were not richer in sodium than ordinary soil contained large percentages of iron. These seem particularly popular with pregnant women. On the whole, it is probably true to say that popularity is associated with either a high content in calcium and sodium, or a high iron content.

In addition to plant ash and edible earths, the water from certain springs is held in high esteem, especially by the women, and is used in cooking. Analyses of 15 samples show a fairly high calcium content in some as compared with different waters in Britain (Appendix I, Table VIII), the highest figure being 43·60 parts per 100,000, and the average 9·83.

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(iii) *Milk from the Masai Reserve.*

The analyses of 13 samples of milk from different herds of Masai cattle are averaged in the following table and compared with average figures for milk from cows at the Rowett Institute.

	Masai Milk. Per cent.	*Home Milk.* Per cent.
Total solids	13·77	12·89
Fat	5·48	3·9
Sugar	4·92	4·8
Nitrogen	·57	·54
Total ash	·73	·75
Ca	·129	·119
Na	·037	·056
K	·143	·168
P	·096	·100
Cl	·095	·111
Fe	·00008	·00009

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M 146 It will be observed that total solids and fat content are high in Masai milk. This is probably due chiefly to the low yield, since yield and fat content tend to be inversely related (Tocher, 1925).

With the exception of calcium, the percentage of the inorganic constituents is lower in Masai milk than in home milk. This is especially marked in the case of sodium. Calculated on the calorie basis the difference is still greater, and even calcium is slightly low.

(c) The Composition of the Daily Diet.

K 126 An attempt was made by Dr. Foster to collect definite data from which the average amount and composition of the food consumed daily could be estimated.

(i) *The Akikuyu.*

Observations were made on the preparation and eating of food in the native villages. The ingredients and bulk of the foods prepared, and the number of people eating them, were noted. In two cases it was possible to have the food weighed for the meals of one day, and samples of the cooked mixture, or of the actual ingredients used, collected for analysis. Other attempts to make accurate observations of this kind failed owing to the belief of the natives that the handling and weighing of the food by Dr. Foster put a "spell"* upon it. K 114 954

It will be recognised that little accurate quantitative data with regard to food consumption could be obtained under such conditions. In addition to the difficulty of getting a sufficient number of weighings or measurements, it was impossible to check incidental food consumption. The amounts of maize in the cob, of bananas, or of other foods, eaten while at work in the field or at other odd times, could not be estimated. It is necessary, therefore, to base our calculations on the samples actually weighed, taking those as representative.

K 262 The two chief meals of the Kikuyu are:—(1) A sort of thick porridge called "irio" (which means food), of which the main ingredients are maize, legumes and plantains; and (2) gruel "ucuru" made from millet flour and water. These foods are taken with some regularity by both sexes. In addition, maize cobs, yams, sweet potatoes and plantains may also be consumed in considerable quantities, either replacing irio and ucuru when convenient, or

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* It is interesting to note that this fear of the natives in the reserves of having a "spell" put upon them, through anything that was done by the investigator, presented great difficulties, not only in connection with the weighing and measuring of food, but also in the weighing and measuring of children. In the reserves, the natives are under the influence of "witch doctors," who evidently resented the practice, in their midst, of what was regarded as a new form of magic.

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supplementing them. It will be seen that the nature of these 262 occasional foods is not different from that of those incorporated in the cooked irio, and an estimate based on irio and ucuru will probably be closely similar to one based on a more detailed dietary.

In addition to the above, the women have certain dishes of which the men, and boys after the age of about 5 years, do not usually partake. These dishes appear to be of considerable importance, causing a differentiation, in certain important respects, between the diet of the males and that of the women and young children. Thus, the women make for their own consumption an irio which is different in composition from that which is made for men, or for a mixed company. Women's irio, in addition to maize, legumes and plantains, contains green leaves and salt or a salt substitute. These [263] are either omitted altogether from the men's irio, or are used in much smaller quantities. Gruel, different from the ordinary ucuru, is also made exclusively for use by the women. This gruel, "mukiro," differs from that prepared for men in having salt or a salt substitute added, and the other women's dishes are distinguished by containing green leaves, special millets, and salt or salt substitutes. Some of these special millets, are credited with medicinal or distinctive nutritive properties. One type in particular is [843] commonly used only during pregnancy and lactation, and is highly [853] esteemed as a lactifacient. This is the red millet, mugimbi or mwimbe.

It will be realised from what has been said above regarding the 146 chemical analysis of green leaves, which contain large amounts of calcium, and of salt substitutes, which contribute considerable amounts of sodium, and may also contribute some calcium to the diet, that the special women's foods increase the daily intake of these elements. It is interesting to note that the lactifacient red millets are very different in chemical composition from the ordinary food millets, containing on an average 14 times as much calcium and 16 times as much manganese.

Comparison of Mineral Content of Ucuru, the common Gruel, with that of Mukiro, the Women's Gruel, and other Women's Foods.

Elements given in gms. per 100 gms. dry matter.

	Ucuru.	Mukiro.	Masura.	Mathia.	Kiroya.
Ca ..	·030	·031	·13	·64	·06
P ..	·380	·330	·30	·34	·31
Na ..	·043	1·050	·253	·137	·217
Cl ..	·066	·11	·11	·11	·13
K ..	·330	·43	·96	·40	·46

146 *Comparison of Composition of the common Irio and of Women's Irio, on the basis of the Average Amounts of these Foods consumed in a Day.*

Common irio.				Women's irio.				
Ingredients.		Composition.		Ingredients.		Composition.		
							(a)	(b)
	gms.		gms.		gms.		gms.	gms.
Maize ..	336	Pro.	60	Maize ..	336	Pro.	82	
Beans ..	161	Fat	6	Beans ..	156	Fat	8	
Plantains ..	231	CHO	142	Plaintains ..	565	CHO	217	
Salt ..	0·9	Ca	·21	Salt ..	4·7	Ca	1·86	1·37
		P	1·9	Leaves ..	106	P	2·19	1·56
		Na	·43			Na	1·56	1·56

Note.—The figures given in column (*a*) are calculated from the analyses of the ingredients used, those in column (*b*) are from the analysis of an actual sample of the cooked food.

262 The diet of the Kikuyu women appears to differ from that of the men in quantity as well as quality. If the women are partaking, in a mixed company, of common irio and ucuru, they are said to eat more of the irio and drink less of the ucuru. Their incidental food consumption is also said to be higher.

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128 The daily food intake, as weighed and measured, was found by Dr. Foster to be, for the men, a ration of irio as shown in the table above, with 1,250 c.c. of ucuru containing 377 grams of millet flour. Women eating the same food had a double ration of irio and half the quantity of ucuru. The ration of women's irio for a day is also shown in the above table. These amounts of food were said to be sufficient for a day without additional food.

The replies to the questionnaire on foodstuffs confirm the above observations as to the general nature of the diet. With regard to the quantities of food eaten, it is of interest, in view of the difficulty of collecting accurate information, to compare such of the estimates in the replies as are capable of expression in figures, with Dr. Foster's actual measurements. Such a comparison is made below.

Average Daily Food Intake of Adult Male Kikuyu.

Dr. Foster	2·7 lbs. irio and 1·25 litres ucuru =	
	Total weight of food	3½ lbs.
	Total dry matter	770 gms.
A.D.C. (Reply No. 61) ..	Total weight of food of all kinds ..	4 lbs.
R.C.M. (Reply No. 57) ..	Irio alone	4½ lbs.
	Total dry matter..	720 gms.
R.C.M. (Reply No. 59) ..	Irio	2½ lbs.
	Other food	4 lbs.
	Total dry matter, about	890 gms.
M.O. (Reply No. 3) ..	Irio, up to..	6 lbs.
	Ucuru, up to	2 pts.
	Total dry matter, up to.. ..	1,240 gms.

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It will be seen that the first three estimates are in good agreement with the actual weighings. The fourth, which is an estimate of the upper limit of food intake, probably represents a quantity well above the usual average.

Taking all the available information together, therefore, it is believed that an estimate based on the samples actually weighed and measured forms a sufficiently accurate approximation to the daily food intake.

(ii) *The Masai.*

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The assessment of the composition of the diet presents fewer difficulties in the case of the Masai. While a certain amount of differentiation exists between the sexes, it is less marked and of less importance than that between Kikuyu males and females. The following figures show the approximate amounts of the different foods taken :—

Average Diet of Masai Male of Warrior Class.

Meat	1,135 grams.
Milk	2,000 c.c.
Blood	50 c.c.

Average Diet of Women and Males, not Warriors.

Meat	450 grams.
Milk	1,400 c.c.
Maize Meal	250 grams.

(iii) *Comparison of the two tribes.*

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On the basis of the above dietaries, the following table has been prepared, comparing the average daily intake of the most important constituents of the diets in the two tribes.

Comparison of probable Average Daily Intake (excluding incidental Food Consumption) of Dietary Constituents by Kikuyu and Masai.

	Kikuyu.			Masai.	
	Males.	Females.		Males.	Females.
		On basis of common diet.	On basis of women's irio.		
	gms.	gms.	gms.	gms.	gms.
Protein	99	140	82	300	165
Fat	22	20	8	160	90
Carbohyd	390	400	220	100	245
Ca	·28	·46	1·86	2·94	2·03
P	3·0	4·4	2·19	4·36	3·19
Na	·48	·88	1·56	1·80	·94

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The above table does not take account of any incidental consumption of maize, sweet potatoes, bananas, or other similar foods, by the Kikuyu. These would increase the caloric value of

K 146 [128] the diet without materially affecting the amounts and proportions of the protein, fat and minerals.

From this table it appears that the diet of the Kikuyu male is adequate in protein* (see discussion below p. 20), but very low in fat. It contains more than enough phosphorus but is very low in calcium and possibly low in sodium. If it be assumed that the women alternate common irio with their own dish, then their protein and fat are much as those of the men. Their phosphorus intake is also roughly similar, but their intake of calcium and sodium is much higher than that of the men. Their daily intake of calcium is over 1 gm., and must be considered to be about the optimum intake.

M 146 In contrast with this picture, the Masai diet contains a liberal supply of the mineral elements and a large excess of protein and fat, but is low in carbohydrates. It must also be low in cellulose and other indigestible residues.

(*d*) Physical Condition.

K M 128 *Measurements.*

In constructing the tables of physical measurements,[1] the data have been arranged in age-groups, up to and including 30 years of age. Actual ages are, of course, not known by the people themselves and, therefore, only an estimate could be made, but the factor of error will be the same with regard to both Kikuyu and Masai. The figures were arrived at as a result of questioning with reference to outstanding events.

The numbers in the different groups are given in Appendix 2 along with the detailed figures. The results are shown in convenient form in the accompanying graphs, in which they are compared with standard English measurements.

K M 141 *Height.*—A comparison of the average heights of Kikuyu and Masai males (Graph 1) of the same age, shows that the Masai grow more rapidly than the Kikuyu and reach a greater mean adult height. At their maximum about the age of 20, there is a difference of almost five inches. At the same age, Masai women (Graph 2) are three inches taller than Kikuyu women. M 145 146 The Masai children appear to grow more rapidly than English children. This may be due to the fact that their chief article of diet is milk, since it has been shown in experiments with Scottish school children that the feeding of additional milk increases the rate of growth (Orr, 1928; Leighton and Clark, 1929). The total number of Masai children measured is, however, too small to make such deductions reliable.

K M 141 *Weight.*—Graph 3 compares the rate of increase in weight of Kikuyu children from birth to thirty months of age compared with that of English and of American infants. During the first month the Kikuyu infants are about half a pound lighter than English.

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* In considering the relative adequacy of Kikuyu and Masai diets it has to be borne in mind that the biological value of the Kikuyu protein is considerably lower than that of the Masai which is derived from meat and milk.

[1] [See Appendix II, Category 116, pp. 77-80--Analyst]

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This is in agreement with observations on the birth-weight of Kikuyu children by Anderson, G. V. (1929). The rate of increase in weight is roughly similar for the first ten months, but thereafter the Kikuyu increase much more slowly than English or American and are about 8 lbs. lighter at 30 months. We have no data regarding the birth-weight or rate of increase of Masai infants.

In Graph 4 the weights of Kikuyu and Masai males are compared with English standards. The Masai male is uniformly heavier than the Kikuyu, but lighter than the English. The difference between Masai and Kikuyu becomes more marked after the age of 15 years, and at the age of 20 the Masai average 23 lbs. more. The difference between Masai and Kikuyu females (Graph 5) is even greater, the Masai approximating to the English standards. The average weight of Masai women in the 21–25 age group is 27 lbs. above that of Kikuyu women. It is noteworthy that Masai of both sexes show, on the average, a decrease in both height and weight after the 25th year. A similar decrease occurs in the Kikuyu, but not until the next quinquennium. Early senility appears to be common to both tribes.

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In addition to being superior in height and weight, the Masai are typically larger in the chest and smaller in the abdomen than the Kikuyu. (Appendix II, Tables V and VI.)

Strength.—Average dynamometer readings at different ages are compared in Graph 6. From the earliest age the Masai give evidence of superior strength. At the maximum the males achieve an average hand pressure of 88·8 lbs., which is 30 lbs. more than the maximum for Kikuyu males. The Kikuyu male shows a strength which, indeed, is just equal to that of the Masai women, and is only at the maximum about 10 lbs. greater than that of Kikuyu women. This evidence of inferior strength on the part of the Kikuyu, especially the male Kikuyu, is supported by what we know regarding his very low capacity for work and power of endurance. Unfortunately, we have no information as to capacity for work in the Masai.

(*c*) Clinical Observations—Incidence of Disease.

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Signs of malnutrition and symptoms suggestive of rickets are common among Kikuyu children, the males particularly being affected. Few cases of early rickets at the typical age came to the field worker's notice, but signs of late rickets were commonly observed in this tribe. Thus, of 1,325 boys examined, 830 (63 per cent.) had some osseous deformity such as genu valgum, genu varum, flat foot, scoliosis, beading of the costochondral junctions, rickety rosary, or cranial bossing.

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It is known that yaws produce bone deformities of many kinds, and it is, therefore, important to know what part of the above deformities may be attributable to yaws. There are no reliable figures showing the general incidence of yaws in children. Philip 1927, 1) gives the incidence amongst school children in one district as about 15 per cent., but this figure is not applicable to the general

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child population since those with active yaws are discouraged from attending school. It is known, however, that bone deformities are produced only in the tertiary stage of the disease. Callanan (1926) noted in about 2,000 cases of yaws in children that 32·1 per cent. of male children and 21·6 per cent. of female children had the disease in the tertiary stage. Hence, even assuming that all children have yaws, and that every case of tertiary yaws involves bony deformity, it is obvious that in at least half of the 62·6 per cent. of male children, and 43·7 per cent. of female children with bone deformities, the occurrence of these deformities cannot be explained as due to yaws.

In addition to bone deformities, 40 per cent. of the boys had some obvious dental defect, 48 per cent. were clinically anæmic, and 62 per cent. suffered from spongy gums. There was also a high incidence of enlarged tonsils and cervical adenitis. The general condition was poor.

Kikuyu girls showed a lower incidence of all defects than the boys and were much superior in general condition.

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The Masai village children present a very different picture, bone and dental defects and anæmia being relatively uncommon.

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The results of the physical examinations are presented graphically in Graphs 7 to 10. It should be noted that, while there appears to be a correlation between diet and the incidence of bone and dental defects and anæmia, there is none between diet and the incidence of enlarged tonsils and cervical adenitis.

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Table showing percentage Incidence of different Defects in Kikuyu and Masai Children.

	Kikuyu.		Masai.	
	Boys.	Girls.	Boys.	Girls.
Bone deformities	62·6	43·7	11·7	14·6
Dental caries	13·7	13·1	1·6	3·6
All dental defects	40·0	28·8	8·3	7·3
Anæmia	47·8	38·9	11·7	8·5
Enlarged tonsils	56·0	53·3	35·0	52·4
Cervical adenitis	52·0	47·6	40·0	59·8

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In the course of the investigation, records of cases attending native hospitals in the Kikuyu and Masai reserves were examined as to the incidence of various conditions. The data for the Kikuyu include figures from the hospitals at Keruguya, Fort Hall, Nyeri and Githumu. Unfortunately, there is only one hospital in the Masai reserve, that at Narok, the seat of the district commissioner and a trading centre. The patients are therefore not all Masai, about 20 per cent. being Indians or natives of other tribes. We have no information as to the distribution of cases between these and Masai. The following table shows the results expressed as percentages of the number of cases analysed :—

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

Average Incidence of various Diseases as percentage of Total Cases.

District.	Total No. of cases.	Yaws.	Malaria.	Bronchitis.	Pneumonia.	Influenza.	Phthisis.	Arthritis.	Rheumatism.	Gonorrhœa.	Helminthiasis.	Ulcers.	Constipation.
Kikuyu : Out-patients ..	45,003	13·8	11·6	14·6	0·3	1·9	0·2	—	2·5	0·5	7·1	8·1	4·7
Kikuyu : In-patients ..	4,204	21·6	24·6	11·1	7·3	1·0	3·7	—	5·0	1·2	10·3	10·9	—
Masai : Out-patients ..	1,161	0·2	1·0	12·1	—	2·9	0·2	4·2	0·3	0·8	0·1	—	26·0
Masai : In-patients ..	132	5·3	1·5	2·3	3·8	3·0	0·8	1·5	—	—	0·8	—	0·8

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14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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It appears at once that the incidence of yaws, malaria, helminthiasis and ulcers is higher amongst the Kikuyu, while, on the other hand, the occurrence of chronic constipation and arthritis is more frequent amongst the Masai. Pulmonary disease appears to be somewhat more frequent amongst the Kikuyu, especially in the in-patients.

It is obvious, however, that hospital statistics cannot truly represent the general incidence of disease in a native tribe. For this reason an attempt was made by the field worker to estimate the proportions of the diseases encountered most frequently in the course of his survey. Altogether, about 12,000 natives of both tribes were seen. Of those who attended for medical treatment, a large number in both tribes required dental extractions, and many were cases of local injury and conjunctivitis. Conjunctivitis is very common amongst the Kikuyu, especially the women, and less common amongst the Masai. The following table indicates approximately the incidence of the most common diseases in the two tribes (as percentages of the total number of cases of these diseases encountered in each tribe) :—

	Kikuyu.	Masai.
Bronchitis	28	4
Pneumonia..	3	—
Tuberculosis	6	1
Ulcers	33	3
Malaria	18	2
Gonorrhœa..	1	8
Intestinal stasis	4	45
Arthritis	2	35
Helminthiasis	5	2

With the exception of pulmonary conditions, this estimate is in good agreement with the hospital data. As regards pulmonary disease, the field worker's estimate is 37 per cent. for the Kikuyu and 5 per cent. for the Masai, while the hospital statistics (calculated on the same basis) show 34 per cent. in Kikuyu and 27 per cent. in Masai. Different possible explanations might be offered for the high figure from the Masai hospital. We have already noted that 20 per cent. of the patients at this hospital are not Masai. The figure for pulmonary disease might possibly be altered to some extent by exclusion of natives other than Masai. Again, we have no information as to possible dietary and environmental differences between Masai living in the neighbourhood of Narok as compared with the more remote parts of the Reserve. In this connection it is of interest to note that Masai prisoners in Nairobi Gaol appear to be particularly susceptible to pulmonary infections (Ann. Med. Rep. Kenya, 1923). It might be thought that their susceptibility is increased by the drastic change in diet and environment to which they are subjected in gaol. It is obvious, in any case, from this observation, that the Masai have

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no marked tribal immunity to pulmonary conditions, and that any superior resistance they may show under natural conditions is probably correlated with either superior diet or environment. KM 164

It was the general impression of the field worker that disease was less common amongst the women in the Kikuyu reserve than amongst the men. This impression is supported, as far as helminthic infection is concerned, by observations by Vint (1929). In a series of post mortem examinations of 104 cases of men and women, only 19, or 18 per cent., were found free from helminthic infection. Of the 104 cases, 11 were women and 4 of them, or 36 per cent., were free from helminths. Similar evidence is found in clinical records of examinations of fæces at Nairobi Medical Laboratory in which 74 per cent. of men were found to be infected and only 49 per cent. of the women.

Tuberculosis also, as judged by hospital statistics, appears to be less common in women than in men. Wilson (1928) says "There is one noteworthy feature of all our tuberculosis statistics, and that is the overwhelming proportion of male patients," and he also states that pulmonary tuberculosis is rare in native children.

There is, of course, always the difficulty about hospital data that it may be argued that women do not go to hospital as much as the men, but even if this is true, since pulmonary conditions constitute a large proportion of all hospital cases, it seems unlikely that the proportion of women with tuberculosis going to hospital would be lower than that of men.

These indications, taken along with the marked superiority of girls over boys as described from the clinical examination of children, and the admittedly superior general condition of women as compared with men, point to an effect on general condition and health of the difference in diet of the sexes. There can be little doubt that the dietary of the young children, the girls and the women, is better balanced than that of the older boys and men, and this appears to be clearly reflected in differences in physique and health. KM 146

III.—LABORATORY AND HOSPITAL WORK.

The laboratory work was carried out by the late Dr. J. M. Henderson in conjunction with Dr. Kelly, Dr. Harvey and other members of the staff of the Medical Research Laboratory in Nairobi, which is under the direction of Dr. W. H. Kauntze. It included analyses of hospital and prison diets and metabolism experiments on native prisoners to determine the effect on weight, composition of the blood, and retention of calcium and phosphorus, of certain additions to these diets. KM 125

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
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(a) A Study of the Adequacy of Hospital and Prison Diets.

The following figures give the prescribed diets and the composition as determined by actual analyses of sample issues.

Native Civil Hospital. Diet "A." Daily ration.		Long Term Prison Diet. Daily ration.		Prison Hospital Diet. Daily ration.	
Beans	6 oz.	Beans	6 oz.	Beans	6 oz.
Beef	6 oz.	Beef*	8 oz.	Beef	8 oz.
Maize (meal) ..	1½ lb.	Maize (whole) ..	1½ lb.	Maize (meal) ..	1½ lb.
Jaggery	1 oz.	Potatoes ..	8 oz.	Potatoes ..	6 oz.
Potatoes and Vegetables ..	6 oz.	Salt	½ oz.	Salt	½ oz.
Salt	½ oz.	Ghee†	1 oz.	Ghee	½ oz.
		Lemons	2 per week.	Lemons	2 per week.

* Given only 3 days per week. † Given only 4 days per week.

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Composition.

	Native Civil Hospital. Average of two samples.	Long Term Prison.	Prison Hospital. Average of two samples.
	gms.	gms.	gms.
Protein	97	116·5	125·3
Carbohydrates ..	487	626	535
Fat	36·8	53·4	48·5
Calories	2,668	3,450	3,079
Fibre	12·3	12	26
Ash	32	20·7	29·3
Ca	·29	·3	·346
P	1·84	2·36	2·65

There are no standards, based on experimental data, for the food requirements of African natives. Breinl and Young (1919–20) reviewing the existing information on dietary requirements in the tropics, conclude that "in general, the requirements in calories, either of white men or coloured natives, does not differ appreciably from European standards." Further, there is no reason to expect that there would be much difference in the relative proportions of the different constituents required. Hence, considering the analyses on the basis of European standards, the caloric value and protein intake appear to be ample. The amount of fat, however, is distinctly below 60 gms., which is regarded by several writers as the desirable amount.

We have little experimental information on the calcium and phosphorus requirements of men. Sherman and his co-workers, from the results of their experiments, consider that the minimum requirement is 0·45 gm. of calcium per man per day. To bring the

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calcium into line with the 100 gm. protein standard, 1 gm. would be required, and this is what Sherman (1920) states to be the desirable amount. The average daily storage for growth has been found by Sherman and Hawley (1922) to be 0·01 gm. per kg. body weight. The amount found by Herbst was 0·01 to 0·016 gm. Hence the requirement for growth in adolescent males would be about 0·5 gm. daily, giving a total requirement of from 1 to 1·5 gms. per day. The calcium content of both hospital and prison diets, amounting on an average to about 0·3 gm. per day, is obviously much below the requirement.

The phosphorus requirement as estimated by Sherman and his co-workers is about 2 gms., corresponding to 1 gm. of calcium. The phosphorus was, therefore, approximately adequate in all diets, and high in the prison diets.

It is impossible to assess in figures the vitamin content of the diets. It was considered, however, that the diets were probably inadequate in respect of vitamins A and D.

The Effect of Additions to the Diet.

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As the examination of the diets had shown that they were probably inadequate in calcium and possibly also in some other inorganic constituents, and that they might also be inadequate in vitamins A and D, it was decided to test the effect of the addition of a mixture of mineral salts and cod liver oil.

Special facilities were given by the Prison authorities for carrying out metabolism experiments on the inmates of Nairobi Gaol. The actual administration of supplements and the collection of material for analysis was under the charge of Sub-Assistant Surgeon Wazir Chand of the Kenya Medical Service.

Experiment 1 : *Adults.*

As the diet was low in fat, and as it had been thought that it might be low in iodine, control observations were made with the addition to the diet of an amount of olive oil equal to the amount of cod liver oil given, and with some potassium iodide, so that, in the interpretation of the results, it would be possible to eliminate the possible effects of the added fat or the iodine in the cod liver oil.

The first experiment was made on 42 subjects who were selected from some 200 male natives serving long term sentences. They were selected as belonging to the same tribe or nearly related tribes. They were full grown, free from obvious disease and of average physique. Their occupations were comparable. The men were divided into five groups, there being 14 men in the control group and seven in each of the others. The average weight in each group was approximately the same at the commencement of the experiment.

The fæces of the 42 selected prisoners were examined for protozoal and helminthic infections with a view to having the positive cases

146 125 deparasitised. It was assumed that the subject was free from parasites if the results were negative on three successive examinations. Differential blood counts and blood examinations for malaria parasites were made, and anti-malarial treatment administered where necessary.

Before the addition of supplements to the diet, the men were under observation for six weeks. The supplements were given for eleven weeks, after which they were withdrawn and the observations carried on for a post-period of five weeks.

The calcium balances of five men (one from each group) were determined simultaneously. In all, twenty men (four representative men from each group) were thus examined over the last four weeks of the supplement feeding period. The collection period in each case was a continuous one of ninety-six hours.

The basal diet was the long term diet as commonly used in the prison. The analyses just quoted showed that the daily intake of calcium on this diet is only about 0·3 gm. (*Note.*—Subsequent control analyses of this and the hospital ration used in metabolism experiments, showed that the daily calcium intake may vary from 0·26 to 0·38 gm. per day. The average intake on these diets is, therefore, probably not much over 0·3 gm.)

The groups and the supplementary additions were arranged as follows :—

Group.	*No. of men.*	*Additions to ration.*
1.	14	None.
2.	7	125 c.c. mineral mixture: 15 c.c. cod liver oil.
3.	7	15 c.c. cod liver oil.
4.	7	125 c.c. mineral mixture.
5.	7	15 c.c. olive oil : 1 mg. iodine as solution of potassium iodide.

The salt mixture was made up to give in the daily dose approximately the amounts of minerals present in 1 pint of cow's milk.

Results.—(1) *Weight.*

The following table shows the changes in weight during the different experimental periods :—

Group.	*Average gain in weight during supplement period.*	*Average gain or loss during post period.*
Control	1·92 lb.	+0·49 lb.
Minerals and cod liver oil ..	2·66 ,,	—0·49 ,,
Cod liver oil	2·55 ,,	+0·41 ,,
Minerals	2·51 ,,	—1·95 ,,
Olive oil and iodine	2·27 ,,	+0·10 ,,

In all the groups there was a slight increase in weight, due probably 146
chiefly to the fact that the men were under more than usually strict 125
supervision, and were encouraged to eat the whole ration. The increases were slightly more in those receiving the supplements than in the controls. The differences are, however, possibly within the range of experimental error.

In the post-period there was a drop in weight of 0·49 lb. in the minerals with cod liver oil group and of 1·95 lb. in the minerals group. The weight was maintained in the cod liver oil group. It is probable that some of the increase in weight in the groups receiving minerals, and the subsequent decrease in the post-period in these groups, may have been due to the effect of the mineral salts on the water content of the body. The fact that there was no decrease in the post-period in the cod liver oil group, and that the decrease in the minerals and cod liver oil group was only a third of that in the minerals group, suggests that the increase in weight on cod liver oil may be a true result. This might be due partly to the oil itself and partly to the vitamin content as, in both periods, the increase on cod liver oil was greater than on olive oil. The differences, however, are so small that they are hardly worthy of serious discussion.

(2) *Blood Calcium.*

The calcium content of the blood was determined in the pre-period, and at the end of the experimental and post-experimental periods. The average for the 42 cases in the pre-period was 9·2 mg. per 100 c.c. serum. The lowest value found was 7·3 mg. Eighteen cases were below 9 mg., and only seven cases were above 10 mg. The normal European range (by the method used, that of Kramer and Tisdall) is 9–11 mg. per 100 c.c. with an average of about 10 mg. The calcium content of the blood of these cases was therefore definitely below European level. That this difference is not due to climatic conditions is shown by the fact that a series of estimations on 13 Europeans in Kenya gave an average about 10 per cent. higher than at home.

These results are in agreement with observations by McCulloch (1929) in Nigeria. He found very low values for blood calcium in natives on a calcium-poor cereal diet. The range in his series of cases was from 6 mg. to 10 mg., and the average was 8·2 mg.

At the beginning of the observations, an attempt was made to correlate the occurrence of these low calcium values with the incidence of syphilis, malaria or intestinal parasites. No correlation could be established with syphilis. The following table shows the distribution

146 of cases above or below 9 mg. per 100 c.c. serum, with respect to
125 malaria and intestinal parasites :—

	Below 9 mg.	*Above 9 mg.*
All cases	18	24
Cases with malaria ..	13	14
„ „ parasites ..	15	10
„ „ both	10	5
„ free from both ..	—	5

Although the numbers are small, the fact that two-thirds of those suffering from both infections were below 9 mg., while all of those who were free from both were above 9 mg., suggests that there may be some correlation between incidence of these diseases and low blood calcium. It should be noted here, however, that in later balance experiments by Dr. Harvey (1929), it was shown that infestation with intestinal parasites had no effect on the assimilation of calcium from a diet similar to the basal diet used in this experiment, either with or without the addition of a calcium salt.

The nature and extent of the changes in blood calcium due to supplement feeding are shown in the following table :—

The Nature of the Blood Changes in the different Groups.

Group.	Basal.	Minerals and cod liver oil.	Minerals.	Cod liver oil.	Olive oil and iodine.
No. in group ..	14	7	7	7	7
Rise	6	7	7	7	4
Fall	8	—	—	—	2
Average Blood Calcium in mg. per 100 c.c.					
Pre-period ..	9·6	9·0	9·2	8·8	8·9
Experimental ..	9·7	9·8	10·0	9·9	9·1
Post-period ..	9·7	9·7	9·7	9·3	9·5

By the end of the experimental period, the blood calcium had increased in all of the subjects in the minerals, minerals with cod liver oil, and cod liver oil groups. In the control and olive oil groups, some had increased and others decreased.

In the post-period there was a tendency towards a lower level again in the minerals and cod liver oil groups, but not in the other two groups.

Before discussing the significance of these results, it is of interest to consider the effects on blood calcium which have been produced in animals by the feeding of ill-balanced diets, and by feeding inorganic calcium salts or cod liver oil.

Kramer and Howland (1922) have shown with rats that the levels of calcium and phosphorus in blood depend to a large extent on the balance of these elements in the diet. A relative excess of phosphorus lowers the serum calcium, and an excess of calcium depresses blood phosphate. The feeding of cod liver oil tends to regulate the level of both elements in the blood. The following figures taken from their paper, illustrate these results :— 146 125

Ca and P per 100 gms. diet : gms.		Ca and P per 100 cc. serum or blood : mgms.			
				With cod liver oil.	
Ca.	P.	Ca.	P.	Ca.	P.
·05	·45	5·5	8·0	8·2	7·0
·18	·45	7·5	8·0	9·6	8·0
1·22	·3	10·0	2·45	10·3	5·7
1·22	1·21	5·0	7·2	—	—
·05	1·06	4·1	8·6	—	—

Normal range :—Serum Ca = 9·5–10·5.
Inorganic P. = 7·0–8·5.

Similar results were obtained on rats by Park, Guy, and Powers (1923) :— 146 114

Ca and P per 100 gm. diet : gms.		Ca and P per 100 c.c. serum or blood : mgms.			
				With cod liver oil.	
Ca.	P.	Ca.	P.	Ca.	P.
0·01	0·29	5·0	6·0	8·8	5·8
0·007	0·59	4·2	11·1	8·6	10·8
0·66	0·47	7·6	6·6	9·0	5·5
1·42	0·26	10·1	1·3	10·7	6·0

These results confirm Kramer and Howland, and show in addition that, if the quantity of calcium in the ration be sufficiently reduced relatively to the phosphorus, the phosphorus level in the blood will be raised.

At the Rowett Research Institute it has been found that in rabbits on a cereal diet the serum calcium tends to fall while the inorganic phosphorus in the blood rises, and similar results have been noted in sheep kept outside. In certain sheep experiments the basal diet was low in calcium and relatively high in phosphorus. Additions of calcium carbonate and cod liver oil were made to it. The effects

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai
Kikuyu FL10
Kenya FL1

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on blood calcium and inorganic phosphorus are summarized as follows :—

Ca and P in diet : gms. per day.		Serum Ca and inorganic blood P : gms. per 100 c.c.			
Ca.	P.	Ca.	P.	With cod liver oil.	
				Ca.	P.
2·23	5·37	7·06	10·53	10·06	7·29
2·42	6·51	6·46	11·32	9·35	7·78
7·93	5·37	9·90	6·84	9·66	6·72
8·12	6·51	8·80	7·88	9·54	6·93

Normal average figures: Ca about 10 mg., P about 4 mg.

It will be seen that when the phosphorus in the food is from 2·4 to 2·7 times the calcium, the blood inorganic phosphorus is greatly increased and the calcium reduced. The addition of either calcium or cod liver oil tends to restore the balance.

Different workers have studied the effect on blood calcium of administration of calcium salts. Bauer and Ropes (1926) and Kahn and Roe (1926) have shown that considerable increases may be caused by large doses of calcium lactate, but these increases are only transitory, and the normal level is soon regained. Feeding extra calcium as bone meal over longer periods, however, Robinson and Huffman (1926) found increases in the blood calcium of calves, which had previously been fed rock phosphate, and showed rather low Ca values. Denis and Minot (1920), from experiments on men, cats and rabbits, conclude that the blood calcium cannot be increased by feeding calcium unless the level is subnormal, and this appears now to be the generally accepted view.

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From these results the conclusion seems justified that the low blood calcium in the Kikuyu native, more especially since it is associated with a high blood inorganic phosphate (see below, p. 42), is the result of a diet in which there is a deficiency of calcium and a relative excess of phosphorus.

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3.—*Calcium Balances.*

The following table shows the average 24 hour balances for the five groups :—

Group.	*Calcium intake—gms. per 24 hours.*	*Calcium balance—gms. per 24 hours.*
Basal	0·3	+0·0093
Minerals and cod liver oil ..	0·98	+0·2437
Cod liver oil	0·3	−0·0661
Minerals	0·98	+0·0659
Olive oil and iodine ..	0·3	−0·0774

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It is obvious that the subjects were roughly in calcium equilibrium, some showing small negative and others small positive balances. The fact that cod liver oil alone had no effect in promoting an increased calcium retention is probably due to the low calcium intake, 0·3 gm. Ca per day as compared with a probable maintenance requirement of 0·45 gm. per day. This finding is in agreement with those of Schabad and Sorochowitsch (1911) and Schloss (1914), who found that the use of cod liver oil was not always followed by an increased retention of calcium. It is also in agreement with the work of Sherman and Macleod (1925) on rats, in which they found that the addition of cod liver oil to a diet low in calcium had no effect on calcification of the bones. Ka 146

In the groups receiving the mineral mixture, the balances were usually definitely positive, and the retention was obviously highest in the mineral group receiving cod liver oil. This is in agreement with all recent knowledge of the effect of vitamin D on calcification.

Experiment 2.—*Growing Boys.*

The results of the first experiment with full grown men had shown that the addition to the calcium-poor prison diet of either calcium or cod liver oil was followed by a rise in the level of calcium in the blood, and that the addition of calcium or calcium and cod liver oil caused an increased retention of calcium. Since the calcium requirements of adolescents are higher than those of full-grown men, it was decided to carry out balance experiments with youths on this diet to determine (1) whether the calcium intake was sufficient to maintain equilibrium, and (2) the effect on the calcium balance of additions to the diet of (*a*) mineral salts, (*b*) cod liver oil, and (*c*) milk. It was thought that such experiments might give some indication of the calcium requirements of adolescents, a subject on which there is little information in the literature. Ka 146 125

For this experiment, five subjects were chosen as being reasonably comparable in age, physical development, general condition and type of prison employment. The average age of the five was 16 years. One of them was a Masai and the other four were Nandi, whose customary diet is approximately the same as that of the Masai. All were employed on gardening work in Nairobi prison where they were serving long term sentences. M N 146 125

As a preliminary, the Wassermann test was made on the five boys: all were negative. Stools were examined for parasites and blood for evidence of malaria. Similar examinations were made periodically throughout the experiment. Treatment was carried out as required and did not interfere with the experimental work.

The experiment was divided into three periods as follows:—

(1) A preliminary period of three weeks during which the subjects were on the usual long term prison diet.

(2) A period of five weeks during which the prison hospital diet replaced the prison diet.

(3) A supplement period of nine weeks in which the additions as specified below were made.

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The basal diets were as already described (p. 20). The additions were as follows :—

Prisoner's No.	*Supplement fed.*
2640	None.
2413	15 c.c. cod liver oil.
1217	Mineral mixture.
2415	Mineral mixture + 15 c.c. cod liver oil.
2534	1 pint cow's milk.

The mineral mixture was identical with that used in the experiment just described. The calcium added to the ration daily in the mineral mixture was 0·68 gm. Ca. From analysis, the calcium content of the milk fed to subject 2534 averaged 0·77 gm. Ca per day. The milk was boiled, as is customary in the Colony.

Results.—(1) *Weight.*

Increases in weight occurred in each case. The largest gains were made by the boys receiving milk and minerals with cod liver oil.

(2) *Blood Calcium.*

The serum calcium was estimated in each of the boys at the beginning of the experiment. The values varied from 10 mg. to 10·6 mg. per 100 c.c. At the end of the supplement period they were practically the same. The average of all the determinations was 10·3 mg., which is within the limits of the normal European range. It is interesting to compare these figures with the previous results on adult prisoners. The latter were all Kikuyu or from tribes with a diet similar to that of the Kikuyu. The average for the 42 cases was 9·2 mg. On the other hand, the boys whose average was 10·3 mg. included one Masai and four Nandi, all with a similar dietary including large quantities of milk. Before admission therefore they would all have had a very high intake of calcium.

(3) *Calcium Balances.*

The calcium balances of each of the five subjects were determined on nine occasions, twice on the prison diet, three times on the prison hospital diet, and four times during the supplement period. The collection period in each case was 96 hours. The following table shows the balances calculated to 24 hour periods.

Average 24 Hour Balances.

Period.	2640 B.	1217 M.M.	2415 M.+C.L.O.	2534 Milk.	2413 C.L.O.
Prison diet .. .. (Ca intake, 0·3 gm.)	+0·0385	−0·0354	−0·2969	−0·1506	+0·0051
Prison hospital diet .. (Ca intake, 0·346 gm.)	−0·0067	−0·1646	−0·2459	−0·0988	−0·2001
Supplement	+0·0434	+0·2509	+0·0962	+0·5058	−0·1364
Ca intake in each case in supplement period.	0·346	1·03	1·03	1·116	0·346

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It will be seen from the table in which the calcium balances are calculated on the analyses already quoted (p. 20), namely, 0·3 gm. for the prison diet and 0·346 for the prison hospital diet, that three of the subjects were on a negative balance on both diets, and two on a positive balance on the former, and a negative balance on the latter diet. We have seen that the calcium in these diets might vary slightly owing to variations in the composition of the beans and potatoes used, but even allowing for the highest figure obtained by analysis, 0·38 gm., the subjects could not have been more than in equilibrium. In growing boys, retention of calcium would have been expected, and indeed, in a later experiment with boys, a small positive balance was found. It is possible that in this experiment, the balance may have been affected by the high calcium intake of the boys on their customary diet before admission to the prison.

Since all the subjects were on the same basal diet, the figures showing the effect of supplement feeding on the calcium balances are comparable. No. 2640 on the basal ration was practically in equilibrium throughout the three periods. The addition of the mineral mixture (No. 1217) changed an apparently negative balance of about 0·1 gm. on an average, to a positive one of 0·25 gm. In No. 2415, the addition of the mineral mixture and cod liver oil changed a negative balance of about 0·27 gm. to a positive one of about 0·1 gm. In No. 2413, the feeding of cod liver oil alone reduced the negative balance of the immediately preceding period, but as compared with the average of the two unsupplemented periods, had no beneficial effect. The greatest difference was seen in the case of No. 2534, the addition of milk changing a negative balance of 0·125 to a positive one of 0·51.

The difference in the calcium balance made by the addition of milk to the diet was therefore 0·63 gm. per day, and the amount of calcium supplied in the milk was 0·77 gm. In the case of the mineral mixture, the amount added was 0·68 gm. and the difference made in the balance was 0·35 gm. This indication of a higher availability of the calcium in milk as compared with that of calcium supplied in other forms is in accordance with the observations of Sherman and Hawley (1922), who found that in children the assimilation of calcium from milk was much higher than from vegetables. The fact that cod liver oil did not materially affect the calcium balances in this experiment would appear to indicate that, in these prison diets, the lack of calcium was of more importance than lack of the factors which affect calcium assimilation. We have already referred to similar findings by other workers.

It is of interest to consider the maintenance requirement in the light of the figures given in the table of calcium balances. The average negative balance of the five subjects throughout the two periods of unsupplemented diet was 0·116 gm. with an average intake of about 0·323 gm. If these figures be accepted as correct, the minimum requirement for equilibrium would appear to be

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0·44 gm. per day, which is in close agreement with Sherman's estimate of 0·45 gm.

Assuming that the maintenance requirement is 0·44 gm. per day, the addition of 0·69 gm. in the mineral mixture would leave a surplus of roughly 0·30 gm. for storage. Of that amount, 0·25 gm. was actually retained, i.e., about 40 per cent. In the case of the supplement of milk, there was a surplus of 0·69 gm., and an actual storage of 0·51 gm. or 75 per cent.

Balance Experiment 3.

The results of the second balance experiment showed that the addition to the calcium-poor basal diet of either milk or a mineral mixture resembling in composition the ash of milk was followed by increased retention of calcium. As cod-liver oil without calcium had little effect on the retention, it was assumed that the chief deficiency in the diet was that of calcium itself. To verify this assumption, another experiment was made in which calcium was added to the diet in the form of calcium carbonate and bone flour, the latter supplying inorganic phosphorus as well as calcium. Both are cheap sources of calcium. Milk and green vegetables are expensive, and at certain seasons difficult to obtain, while the elaborate mineral mixture used entailed considerable work in preparation and was also expensive.

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For this experiment five Nandi boys, of an average age of 18 years, were chosen as being comparable in physique and general condition. The preliminary treatment of the subjects and the experimental methods were as in the previous experiment.

The basal diet was the prison hospital diet. Analyses showed the calcium in a day's ration to be 0·38 gm. and the phosphorus 2·90 gm. Both were slightly higher than in the last experiment. The calcium carbonate used was a pure sample; the bone flour was a finely ground local product. The supplement feeding was arranged as follows :—

Period.	No.	Diet.
Pre-period— Four 3-day collections ..	—	All on prison hospital diet.
First supplement period— Eight 3-day collections ..	1961	$CaCO_3$.
	2231	Control.
	2413	Bone flour.
	2428	Bone flour.
	2341	$CaCO_3$.
Post Period— Six 3-day collections.. ..	—	All on prison hospital diet.
Graded supplement period— Five 3-day collections ..	1961	Bone flour.
	2231	$CaCO_3$.
	2428	$CaCO_3$.
	2341	Bone flour.

The experiment, which continued for 101 days, was divided into four periods: (1) a pre-period of 14 days when the basal ration only was fed; (2) a period of 35 days, during which the calcium intake was raised to about 1 gm. per day by addition of calcium carbonate or bone flour; (3) a post-period of 21 days when the basal diet was again fed alone; and (4) a second supplement period in which the intake of calcium was graded from 1 to 2 gm. total calcium per day. 146
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The phosphorus balances were determined during the latter half of the post-period and throughout the second supplement period.

Results.—The results are shown in the next table.

No. of subject.	Period.	Ca intake.	Ca balance.	P intake.	P balance.
1901	Pre	·38	·13	—	—
	$CaCO_3$ addition	1·08	·70	—	—
	Post	·38	·12	2·00	·77
	Bone flour addition ..	2·08	1·06	3·00	1·27
2331	Pre	·38	·00	—	—
	Control	·38	·12	2·00	·90
	$CaCO_3$ addition	1·58	·67	2·00	·66
2413	Pre	·38	·09	—	—
	Bone flour addition ..	1·08	·66	—	—
	Post	·38	·16	2·00	·76
2420	Pre	·38	·15	—	—
	Bone flour addition ..	1·08	·68	—	—
	Post	·38	·14	2·00	·77
	$CaCO_3$ addition	1·08	·41	2·00	·67
2341	Pre	·38	·06	—	—
	$CaCO_3$ addition	1·08	·69	—	—
	Post	·38	·08	2·00	·90
	Bone flour addition ..	1·58	·41	3·30	·71

In this experiment the average balances in each basal diet period were all positive. It will be seen that, in the first period in which additions were made to the diet, the retention of calcium rose in every case. The addition of 0·7 gm. of calcium raised the average balance from 0·11 gm. to 0·64 gm., which is equivalent to a retention of 75 per cent. of the added calcium, or over 60 per cent. of the total as compared with a retention of only 29 per cent. on the lower calcium intake of the pre-period. This effect of increased intake on percentage utilisation of calcium has been observed in animal experiments. In an experiment on pigs at the Rowett Institute, a small increase in the calcium intake of 0·323 gm. per day caused an increased retention of calcium of more than twice the amount added (Magee and Harvey, 1926).

In the second supplement period in which the calcium intake was varied, raising the calcium intake of subject 1901 from 1·08 *to* 2·08 gm. per day increased the daily retention from 0·70 to 1·06 gm.

146 On the other hand, in subject 3341, raising the intake from 1·08 to
125 1·58 gm. was followed by an actual decrease in retention from 0·69 to 0·41 gm. per day. The results in these two cases are not sufficient to make it worth while considering whether increasing the intake above 1 gm. per day would increase the retention above the level reached on 1 gm. It is impossible, therefore, to offer any opinion as to the optimum intake of calcium, but it is evident that, at a level of 1·08 gm. per day, more than the 0·5 gm. stated to be necessary for growth would be supplied.

The differences between the balances of the subjects on bone flour and of those on calcium carbonate were not marked, 0·48 gm. and 0·68 gm. on bone flour as against 0·41 gm., 0·69 gm. and 0·70 gm. on calcium carbonate. It is evident that, with this prison ration, either bone flour or calcium carbonate can be used as a satisfactory source of calcium. The addition of either brings the ratio of calcium to phosphorus in the diet to about 1 : 3 as contrasted with a ratio of 1 : 8 in the unsupplemented diet.

The phosphorus balances were determined in the post-period and second period of supplement feeding to ascertain the amount of phosphorus retained on the basal ration, and the effect on this retention of calcium carbonate and bone flour. It was found that the amount retained on the unsupplemented ration varied from 0·6 to 0·9 gm. per day. It has been estimated by Sherman and Hawley (1922) that the retention should be about 0·008 gm. per kilogram of body weight, i.e., about 0·5 gm. in the case of these youths. It is evident, as was expected, that the assimilation and retention of phosphorus is adequate. The diet contains 2·9 gm. phosphorus, which, according to Sherman's estimate, is ample.

The addition to the diet of bone flour, which contains 15 per cent. of phosphorus, raised the retention in one case from 0·77 gm. to 1·27 gm., and in the other case from 0·60 gm. to 0·71 gm. The addition of calcium carbonate, on the other hand, decreased the retention of phosphorus from 0·90 gm. to 0·46 gm. in one case, and from 0·77 gm. to 0·67 gm. in the other. It is evident, however, that neither of the additions prevented the assimilation and retention of the amount of phosphorus required, and, indeed, either with or without the addition, sufficient phosphorus was being retained.

Effect of Supplement Feeding on Weight.

Throughout the third balance experiment, the subjects were weighed weekly. In addition, a second feeding experiment on adult prisoners was made, using the subjects from the first experiment. One group received supplements of minerals and cod liver oil for a period of 10 weeks, while the other acted as control. After this time the supplements were withdrawn from the one group and given to the other.

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The general impression formed by Dr. Henderson in the course of these experiments, as recorded in his notes, was that increase in weight was, on the whole, associated with improvement in general condition, and his calculations and graphs, which are not included in detail in this report, indicate that increase in weight was associated with supplement feeding in any form. This suggests that the subjects were in a state of under-nutrition.

It is doubtful, however, whether any great significance attaches to weight increase in adult or nearly adult subjects. The increase may be in great part due to deposition of fat, and may be affected by differences in rate of emptying of the bowel and other factors.

The following table summarizes the results of the balance experiments :—

Results of Balance Experiments—Calcium.

Experiment.	Ca intake gm. per day.	Additions.	Nature of average balances.
1. Adults ..	0·3	.. ..	Approximate equilibrium.
	0·98	Mineral mixture with or without cod liver oil.	Positive balance of 0·155 gm.
2. Growing boys	0·3	.. ..	Barely in equilibrium.
	0·3	Cod liver oil	No effect.
	1·03	Mineral mixture with or without cod liver oil.	Positive balance of 0·170 gm.
	1·12	Milk	Positive balance of 0·51 gm.
3. Growing boys	0·38	.. ..	Positive balance of 0·11 gm.
	1·08	$CaCO_3$ or bone flour ..	Positive balance increased to 0·64 gm.

Results of Balance Experiments—Phosphorus.

3. Growing boys	2·80	.. ..	Positive balance of 0·76 gm.
	2·80	$CaCO_3$	Positive balance of 0·565 gm.
	3·60	Bone flour	Positive balance of 0·90 gm.

(b) Feeding Test at Kabete Reformatory.

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It was intended to carry out feeding tests both with labour gangs and with growing children to see whether the supplements which had been shown to produce improvement in the calcium balances would affect the rate of growth of children and the condition and working capacity of the men. Owing partly to the illness of Dr. Henderson, and partly to unforeseen difficulties, it was found

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125 impossible to do more than one such test. This test was made at Kabete Reformatory, under the supervision of Captain Wood, the Superintendent. A complete record of the data obtained has been submitted by Dr. Harvey.

146 The boys on whom the test was made belonged to different tribes.
125 Their ages varied from 10 to 17 years as judged by appearance, no exact records being available. They were engaged on farm work, carpentry or masonry, under the supervision of Europeans.

The diet used during the experiment was that prescribed by the Government and had the following composition.

Monday, Wednesday, Friday, and Saturday

1 lb. whole maize.
½ lb. maize meal.
¼ lb. beans.
1 oz. ghee.
½ oz. salt.

Tuesday, Thursday, and Sunday.

4 lb. potatoes.
½ lb. maize meal.
¼ lb. beans.
1 oz. ghee
½ oz. salt.

There were four groups each of 40 boys. One group, the control, received the above diet alone. A second group was given ½ lb. extra maize meal and a third group received the same amount of maize meal with 2 gms. of bone flour added. The bone flour was added to the maize before cooking. The fourth group received the equivalent of 1 pint of skimmed milk made up from a dried milk powder.

All the boys were weighed on the first Saturday of each month. The experiment was commenced on 12th August, 1928, and supplement feeding stopped on 1st March, 1929.

The results are shown in the following table:—

Feeding Test at Kabete Reformatory.

Diet.	Average heights—inches.			Average weights—lbs.		
	August.	March.	Increase.	August.	March.	Increase.
Basal	62·096	62·809	0·713	102·588	108·235	5·647
Maize	62·404	63·389	0·985	103·981	109·673	5·692
Maize and bone flour.. ..	62·143	63·079	0·936	102·593	109·007	6·414
Milk	62·112	63·105	0·993	104·835	113·362	8·527

Although the experiment started with 40 boys in each group, the numbers were reduced during the experiment on account of admissions to hospital or discharges from the Reformatory. The numbers at the end of the experiment were: control, 34; maize, 39; maize and bone flour, 35; and milk, 38.

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The average increases in height were calculated separately for boys estimated to be between 10 and 15 years of age. Allowing for any error in estimating ages, it may be taken that this group would all be actively growing, and any effect on rate of growth might be more evident than in the boys taken all together. The results were as follows :—

Average Increases in Height in Boys aged 10 *to* 15.

Diet, August to March.	*Inches.*	*No. of boys.*
Control	0·779	26
Maize	0·983	30
Maize and bone flour	1·009	29
Milk	1·190	21

The most striking feature of the results is the very definite increase in rate of growth with each of the supplements. In the younger age groups, as expected, the height increases are somewhat greater than in the boys taken altogether, and in the younger boys the rate of increase in height is greater on maize, supplemented with bone flour, than on maize alone. In both younger boys and all the boys together the increases, in both height and weight, are greatest with the milk addition to the diet. The fact of the increased rate of growth with the supplement of maize alone may be explained on the extra calorie consumption. The additional maize supplied about 400 calories, the additional milk about 200. The total basal diet, estimated on the amount supplied, and with no allowance for wastage, yielded approximately 3,200 calories. This intake for growing boys engaged on farm, carpentry or masonry work appears to be low. Lusk (1921) allows 3,400 calories for a man of 70 kg. engaged in medium work, and Cathcart and Orr (1919) estimated the requirements of young recruits of 17 to 19 years of age, in training, to be 3,376 calories. The fact that there was such a definite increase in height with the added maize suggests that the basal diet was inadequate as a source of energy for growing boys who were working.

The addition of bone flour to the diet was not accompanied by any increase in rate of growth in the entire group of boys. There was a slight superiority in weight increase. In the younger boys, however, bone flour showed a slightly greater rate of growth. A six months' experimental period is probably too short to show whether or not the addition of bone flour has any marked effect on growth. It has been shown in the balance experiments, that growth may continue even when little calcium, or none, is being deposited, and it is probable that, in the growing subject who had been on a

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calcium deficient diet, the first effects of increasing the intake of calcium would be in the consolidation of the existing bone rather than in increased rate of growth in length. The suggestion of a favourable effect on the younger boys, however, points to the desirability of further tests. It would also be of interest to determine in tests carried over much longer periods whether increases such as those procured in this experiment represent merely temporary stimulation of growth, or whether they would be maintained and represent true increases in height.

After supplement feeding was stopped, the measurements of height and weight were continued from March to September. The results are tabulated below.

Diet.	Average heights—inches.			Average weights—lb.		
	March.	September.	Increase.	March.	September.	Increase.
Basal	62·533	63·192	0·659	107·067	108·442	1·375
Maize	62·955	63·741	0·786	107·366	108·071	0·705
Maize and bone flour ..	62·863	63·540	0·677	107·669	109·065	1·396
Milk	62·986	63·743	0·757	112·871	111·643	−1·228

It will be seen that the rates of increase in both height and weight are less in all groups than in the period August to March. As regards height, the beneficial effects of the supplements appear to be carried over into the post period, but only the maize and bone flour group continued to put on weight at a greater rate than the controls.

The superiority of the results with milk during the feeding tests is in agreement with the results of milk feeding experiments on school children in Scotland (Orr, 1928, Leighton and Clark, 1929). In these tests, made on 1,157 children, quantities of milk varying from ¾ of a pint to 1 pint of milk, according to age, were fed from November, 1927, to June, 1928. Half of the children received milk and the other half a supplement of biscuits equal in caloric value to the milk. The average increases in height in the milk group were 23·5 per cent. greater than in the controls, and the average increases in weight 45·37 per cent. greater.

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(c) The Etiology of the Tropical Ulcer.

Since tropical ulcer is so common amongst the Kikuyu and comparatively rare amongst the Masai, and since the dietary habits of these two tribes are very different, it was thought that some deficiency in the diet might be a predisposing cause. A study of the etiology, with special reference to the nutritional state of the patients, was therefore made. Clinical data, with notes on the effect of different forms of dietary treatment, were collected in 140 cases, and blood

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examinations were made to ascertain whether any differences could be detected between ulcer and non-ulcer cases.

(i) *Description of Ulcers.*

The ulcers occur chiefly on the lower outer part of the legs, most commonly of all on the lower outer aspect of the left leg. On admission to hospital they vary in diameter from about 1 to 6 ins., the edges being raised and of low vitality, and the floor covered with blood-stained exudate and foul-smelling debris. In many cases tendons protrude and are necrosed, and in some the bone is exposed and possibly dead or dying. Bacteriological examination showed a characteristic combination of Vincent's fusiform bacillus and a spirochæte. It should, however, be noted that each of these organisms has been regarded as accidental contamination, *e.g.*, by Mendelson (1918) in the case of the spirochætal infection, and Mei (1920) in the case of Vincent's bacillus.

(ii) *Associated Conditions.*

(*a*) *Trauma.*—In 125 cases, for which histories were obtained, trauma was said to have occurred in 92. Among farm labourers a prick by hard sisal leaves was the commonest injury. Such slight injuries must, however, be of almost daily occurrence in natives with bare feet and legs, either in the bush in the case of those in the reserves or in labour gangs, more especially on sisal plantations. There appears from the replies to the questionnaire on this subject to be a concensus of opinion amongst medical officers that immediate treatment of injuries, however slight, leads to a decrease in the occurrence of ulcers, and protection of the feet and legs greatly reduces the number of cases. While, therefore, it must be admitted that slight injuries do doubtless precipitate the development of ulcers and determine their location, it is difficult to believe that they are the sole cause. Indeed, there appears to be a general impression that, although trauma may be the immediate exciting cause, there is an underlying condition which predisposes to the development of ulcer, and retards its healing. Malaria, syphilis and intestinal parasites have been suggested as predisposing causes.

(*b*) *Malaria.*—It has frequently been stated that the incidence of tropical ulcer shows a close parallelism with that of malaria. In the present investigation, 123 ulcer cases were examined for malaria, and 28, i.e., 22·8 per cent., were positive. According to observations by Colonel James (1929), the proportion of native children whose blood contains malaria parasites may vary from 33 to 80 per cent., and Brennan (1926) found in Kisumu that of 1,000 slides examined for malaria parasites, 507 were positive. Anderson, T. F. (1929) in Teita found the incidence of malaria in adults to be 30 per cent., and Ross (1929) in the Kavirondo Reserve, found an incidence of 35 to 50 per cent. in the general population. It is obvious that, in the cases studied, the incidence of malaria was not higher than that in the general population.

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From the replies to the questionnaire issued by the Medical Department, it is difficult to establish any correlation between malaria and ulcers, the incidence of malaria in ulcer cases, as stated by different correspondents, varying from 0 to 100 per cent. As far as this brief study goes, there is, therefore, no evidence that malaria is an important predisposing cause of ulcer.

(*c*) *Syphilis.*—It has been suggested by some writers, *e.g.*, Stitt, that most cases of tropical ulcer are syphilitic in origin. In the present study of 123 cases, 15 per cent. showed a positive Wassermann. The following table shows how this compares with the percentage of positive reactions in sections of the general native community examined :—

Subjects.	*No. examined.*	*Percentage with definitely positive Wassermann.*
Kenya police	55 ..	29
Prisoners in Nairobi Gaol ..	100 ..	43
Ulcer cases from Kisumu ..	165 ..	55
Ulcer cases at native hospital ..	123 ..	15·4

It has to be remembered that a positive Wassermann is found in cases of active yaws. As far as these figures go, therefore, there does not appear to be any correlation between incidence of syphilis and that of ulcers. This is in accordance with results obtained by Halpin (1918), who found only one positive Wassermann in a total of 35 cases examined, and with the observations in Cocos and Perim of Edge (1921), who found no correlation between syphilis and ulcers.

(*d*) *Intestinal parasites.*—In 122 cases examined, 78·7 per cent. were found to be infected with intestinal parasites. Helminthic infection was found in 73·8 per cent. of the cases. These figures are compared in the following table with the incidence as determined by Callanan (1927) in 1,000 cases in the native hospital, including ulcer cases :—

	General hospital cases (including ulcers).	*Ulcer cases.*
Intestinal parasites ..	75 per cent.	78·7 per cent.
Helminths	65·8 „	73·8 „

There is a higher incidence of intestinal parasites, especially helminths, in ulcer cases, but it is doubtful whether the difference is significant. The incidence of intestinal parasites in the general native population varies rather widely. Ross (1929) in the Kavirondo Reserve found the incidence varying from 27·5 to 70·6 per cent. Philip (1927, 1, 2) in the Wateita found an incidence of 61 per cent. in the general population and 97 per cent. in 34 coast prisoners. Briscoe (1929) found 57 to 82 per cent. infected amongst the Wakamba.

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Hence the incidence of parasites in ulcer cases is not conspicuously higher than in the general population, and since in 22 per cent. of the ulcer cases the presence of intestinal parasites could not be demonstrated they cannot be regarded as an important etiological factor.

(*e*) *Tribal, sex, and seasonal incidence.*—The most outstanding feature with regard to the tribal incidence of ulcer is that brought out by the survey (p. 34), namely, the high incidence amongst the Kikuyu, and the relatively low incidence amongst the Masai. This is confirmed by the replies to the questionnaire which state that true indolent ulcer is rare amongst the Masai but common amongst the Wakamba, Kavirondo, Kikuyu, Luo and Lumbwa tribes. Ulcer is relatively uncommon also in the Swahilis. We have not sufficient evidence to enable us to say whether racial differences can be correlated with ulcer, but the prevalence of the condition throughout the tropics makes this appear unlikely. With regard to diet, the difference between the Masai and Akikuyu has already been discussed in the first section of this report, and it is known that the Swahili have a mixed dietary. The diets of the other tribes mentioned above, in which ulcer is common, are somewhat similar to that of the Akikuyu.

As regards sex incidence, of the 140 cases studied in this investigation only 3 were women. This however cannot be taken as any indication of the relative incidence in the two sexes, since a high proportion of the cases in Nairobi Hospital are derived from labour gangs. Of the replies to the questionnaire which dealt with the question of sex incidence, 5 stated that ulcer is more common among men, 2 among women, and 4 that there is no sex difference. Among the subjects weighed and measured by the field worker, there were more ulcers in adult females than in adult males, but among the children examined, ulcers were more common in the boys. In the Kikuyu Reserve at least, the women do most of the hard work and are consequently likely to be more exposed to injury than the men. On the whole, the balance of evidence seems to point to a somewhat higher incidence amongst men than amongst women.

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It is interesting to note that the admissions of ulcer cases to hospital commonly increase just as the long rains break. This is a season when disease amongst cattle is said to be more frequent. Since the growth of vegetation, and consequently the diet of both cattle and natives is affected by the rainfall, the high incidence of ulcer at the end of the dry season suggests the implication of a dietary factor.

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Indirect evidence in the same direction is afforded by Breinl's (1915) survey of disease in British New Guinea. He found that there was a marked regional difference in the incidence of ulcer depending on the use of sago as the staple article of diet, and the consequent frequent slight injuries from the spines on the leaves and

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000 trunk of the sago palm. Although Breinl gives no details regarding the dietary, we know from the work of Cilento (1926) and Strong (1927) that the food of the natives of New Guinea is chiefly carbohydrate, and that the general condition and health is poor. Edge also considers that dietary deficiencies play an important part in the etiology of ulcer.

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Such information as could be collected in the present study of the etiology of ulcer seems to warrant the tentative conclusion that neither malaria nor syphilis can be regarded as causative agents. The influence of intestinal parasitic infestation, if any, is not prominent. Trauma is probably an important exciting cause, superimposed upon a condition of low resistance, which is probably the most important factor, in as far as it decreases the natural healing powers and increases susceptibility to invasion by the characteristic micro-organisms. This condition of low resistance may possibly be correlated with dietary deficiencies.

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(iii) *Effect of Dietary Treatment on Rate of Healing.*

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The effect of various additions to the diet on the rate of healing was studied in 140 cases. These were divided between two wards to facilitate the treatment. The ordinary hospital diet (p. 20) was used as the basal diet. The additions consisted of tomatoes, lemons, cod liver oil, a mineral mixture similar to that used in the prison metabolism experiments, and milk. These additions were, at one time, given all together, later the tomatoes, lemons, cod liver oil and mineral mixture were given in one ward, and milk in the other.

In addition to the dietetic treatment, the routine hospital treatment, consisting of saline baths, eusol dressings and fomentations, and, where indicated, scrapings, was continued.

The patients were weighed regularly, and daily clinical notes were taken of the general condition of the patients and the rate of healing of the ulcers. This material does not lend itself to statistical treatment. All that can be given is a descriptive account, with the conclusions reached by the observer from the mass of detailed data recorded in the course of the investigation.

In the first period, all the supplements referred to above were added to the hospital diet for one ward. This was followed by an improvement in general condition of the patients, increase in weight, and " according to the general impression " of the observer, more rapid healing of the ulcers. Later, the milk ration was withdrawn from this ward and given to the control ward, after which no detectable difference was noted in the rates of healing in the two wards. The milk appears, therefore, to have been of as much value as all the other supplements together.

The observer emphasises the fact that in no case, either with the supplements all together, or separately, was there any dramatic improvement in the rate of healing. The only conclusion possible

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was that the supplements improved the condition of the patients, and pari passu with this improvement there appeared to be a more rapid healing of the ulcers.

This conclusion is supported by a consideration of the gains in weight of the patients and the number of weeks required for recovery, a comparison of which affords the only quantitative measure of the effect of supplement feeding. The data are shown in the following table :—

Age.	20–22.	Over 25.	Under 16.	23–25.	17–19.
Number in group	6	23	32	11	19
Gain per man per week in oz.	13·3	12·8	10·6	8·8	8·4
Weeks to recover	8·3	10·2	10·5	11·7	12·9

It will be seen that the rate of increase in weight is not correlated with the age of the subjects.

The conclusion cannot, however, be taken as more than an indication, since it cannot be assumed that all cases were at the same stage and of the same degree of severity, and since some were discharged before healing was complete.

The dietary tests, therefore, showed that none of the substances tried had any marked effect on the rate of healing, but that the rate of healing appeared to be correlated with the general condition of the patients.

(iv) *Blood Examinations in Ulcer and Non-ulcer Cases.*

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In order to ascertain whether ulcers could be associated with any constant deviation from the normal in the composition of the blood or in physiological adjustments, the calcium and inorganic phosphorus content of the blood were estimated, the sugar tolerance and blood pressure determined, and blood counts made in a number of ulcer and non-ulcer subjects.

(*a*) *Calcium content.*—Estimations of serum calcium were made on 90 prisoners and farm labourers not suffering from ulcers, and on 57 ulcer cases, with 13 Europeans as controls. The following figures show the ranges and averages :—

Serum Calcium—mg. per 100 *c.c.*

Class of case.	No.	Range.	Average.
Prisoners and farm labourers ..	90	7·3 to 11·0	9·4
Ulcer cases	57	7·0 to 11·2	9·7
Ulcer cases on admission	46	7·0 to 11·2	9·6
Ulcer cases on discharge	11	9·7 to 11·2	10·3
Europeans	13	10·7 to 12·5	11·2

164 The average for the Europeans is about 10 per cent. above the
149 generally accepted average for healthy individuals in Europe or
125 North America. The average for the natives, whether suffering from ulcers or not, is low. In the five cases in which figures for blood calcium are available both on admission and discharge, the effect of additions to the diet was to increase the calcium, confirming the work on prisoners. The figures were as follows :—

Serum Calcium in Ulcer Cases—mg. per 100 *c.c.*

On admission.	On discharge.
9·5	9·9
9·6	10·9
9·7	10·1
9·3	10·3
10·6	10·5

We know of only one other series of observations on blood calcium in ulcer. In twelve Asiatics, of whom six were suffering from ulcer, Dr. Byron in Malaya (communicated) found that serum calcium in the ulcer cases was lower (9·2 mg.) than in the healthy cases (9·8 mg.), but it was higher than in anæmia (8·5 mg.) or keratomalacia (7·0 mg.)

In the present series the ulcer cases showed, on the whole, a higher blood calcium than non-ulcer cases. The difference from the point of view of the calcium alone is probably not significant. This will be discussed further in connection with the estimations of blood phosphorus to be described.

(*b*) *Inorganic phosphorus content.*—A series of fifty-seven estimations of inorganic phosphorus in blood was carried out, with the following results :—

Inorganic Phosphorus—mg. per 100 *c.c.*

Class of case.	No.	Range.	Average.
Europeans	17	2·70 to 3·83	3·43
Non-ulcer natives	15	2·60 to 4·69	3·68
Ulcer cases	25	3·55 to 5·65	4·55

The average for Europeans is slightly above the generally accepted average for Europeans at home. Kay and Byrom (1927) give 3 mg. as the average of 31 cases. This corresponds roughly with the 10 per cent. increase in calcium, and might be attributed to the effect of sunlight. The non-ulcer native cases are higher than Europeans, and the ulcer cases are considerably higher than the non-ulcer.

Urea concentration tests were made to show whether the high inorganic phosphorus was due to renal insufficiency. The following were the results of tests carried out immediately after the withdrawal

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of blood for phosphorus determinations, 15 gm. urea being given in each case :—

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Urea Concentration Tests.

Inorganic P.		Hours after administration of urea.			
		1.		2.	
Ulcer case.	Mg. per 100 c.c.	Urine vol.	Urea.	Urine vol.	Urea.
		c.c.	%	c.c.	%
1	4·17	310	0·85	130	2·54
2	4·72	200	1·16	80	3·00
3	4·08	162	1·86	72	4·00
4	5·26	115	2·00	70	4·37
5	6·02	610	0·78	80	3·90

It will be observed that the concentration of urea is within normal limits, being in all cases over 2·0 per cent. in the second hour (the accepted standard, Maclean, 1924). Hence the very high blood inorganic phosphorus in ulcer cases cannot be attributed to renal insufficiency. The general fact of an increase is, however, in agreement with what we have seen to occur with diets ill balanced in having an excess of phosphorus and deficiency of calcium.

(*c*) *Sugar tolerance.*—In 34 subjects, of whom 16 were ulcer cases, the sugar tolerance was investigated. Tests were also made on three Europeans as a control against the possible effect of climatic conditions.

The detailed results are given in Appendix 3. Graph 11 shows the nature of the results obtained. It will be seen that the Europeans conform fairly closely to the standard curve. The natives, on the other hand, show a distinct lag. This is in agreement with tests on Indians by Bhatia and Coelho (1925), who found that those accustomed to a vegetarian diet, chiefly carbohydrate, showed a lag in the rate of return to normal after ingestion of glucose. There is little difference between the curves for ulcer and non-ulcer cases.

(*d*) *Blood pH and alkali reserve.*—It was intended to investigate the pH and alkali reserve of the blood but, owing to delay in the transit of apparatus, the work had just begun when Dr. Henderson became ill. The only available data are a few preliminary observations on the pH, which showed no marked deviation from the normal.

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(*e*) *Blood-pressure.*—Blood-pressure estimations were made on a number of Kikuyu, both on indoor and outdoor work, and on ulcer cases. With these were compared estimations on natives belonging

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to other similar tribes, on Masai and on Europeans. The following table summarises the results :—

Blood-pressure—mm.

Tribe.	Kikuyu in-doors	Kikuyu out-doors	Kikuyu all	Others in-doors	Others out-doors	Others all	Masai	Euro-peans	Ulcer cases
Number	40	14	54	31	15	46	26	16	31
Average age	29	28	28	24	32	27	28	29	19
Systolic	110	119	112	111	123	115	117	118	98
Diastolic	76	82	77	79	87	82	79	75	64
Pulse P.	34	37	35	31	36	33	38	41	35
Weight, lbs.	127	130	128	132	128	128	133	—	—

The figures for Europeans correspond fairly closely with the normal standard, with a tendency to be slightly low. This is in agreement with other observations (Breinl and Young, 1919-20 : Roddis and Cooper, 1926 : Fleming, 1924). The ulcer cases are definitely lower than non-ulcer, and statistical analysis showed the difference to be significant. There is, however, a difference in average age between the two classes, which may account for at least part of the difference in blood pressure. Analysis of the data shows that there is little difference between ulcer cases over 20 years of age and those under 20, the former giving an average of 99 mm. and the latter 98. It is probable, therefore, on the whole that blood pressure may tend to be low in ulcer cases. It is most likely that this depends not so much on the ulcer *per se*, as on the lowered vitality and restricted activity of the patients.

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(*f*) *Blood cell counts.*—Cell counts were made on 28 ulcer cases with 21 non-ulcer cases and eight Europeans as controls. The results were as follows :—

	Europeans.	Non-ulcer natives.	Ulcer cases.
Leucocytes	10,725	9,590	11,978
Erythrocytes	5,835,000	5,590,000	5,687,000
Hæmoglobin	91·5%	86·0%	81·2%
Colour index	0·95	0·92	0·85
Polymorphs	64·5	47·0	41·0
Lymphocytes	27·5	41·0	45·0
Large mononuclears	4·2	4·2	7·1
Eosinophiles	4·0	7·1	5·1

There was a lymphocytosis in all natives, ulcer and non-ulcer cases. In ulcer cases the hæmoglobin was somewhat low, but the difference is probably not significant. A diminution in polymorphs and increase in eosinophiles has been observed by others in Europeans in the tropics (Breinl and Young, 1919-20).

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(v) *Conclusions.*

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In all these blood examinations, the only outstanding point of difference between ulcer and non-ulcer cases is the high inorganic phosphorus in the blood in ulcer. It is of interest to consider the calcium and inorganic phosphorus results together :—

	Serum calcium, mg. per 100 *c.c.*	*Inorganic phosphorus, mg. per* 100 *c.c.*
European standards ..	10·0 to 10·5 ..	3
Europeans in Kenya ..	11·4 ..	3·43
Non-ulcer natives ..	9·4 ..	3·68
Ulcer cases	9·7 ..	4·55

It appears very unlikely that the alteration in balance of calcium and phosphorus in the blood of the natives should be in any way due to environmental influences, since both elements are increased in approximately the same proportion in Europeans. We have already seen that a shift in the direction of high phosphorus, low calcium, occurs in experimental animals on diets containing an excess of phosphorus and deficient in calcium, and the lack of balance in the native dietary, which is closely similar to these experimental diets, would suffice to explain a high phosphorus and low calcium content in the blood. It does not, however, explain the difference between ulcer and non-ulcer cases, for the ulcer cases are so much higher in inorganic phosphate than the non-ulcer that their calcium would be expected to be significantly lower. Instead of being lower, it is at least as high.

It would be of great interest to know whether in the individual case a rise in calcium or phosphorus occurs subsequently to the development of ulcer, and also whether any change occurs in the form in which calcium is present in the blood. It has been suggested by Greenwald and Gross (1925) that part of the calcium may normally be held in solution in the blood as calcium phosphate, which would be physiologically inert. An increase in this fraction might be thought to occur. Further, Ashford and Hernandez (1926), in analyses of the blood of over 500 subjects in Porto Rico, report that blood calcium is low, relatively to accepted standards, especially in cases of " nutritional unbalance," and that the decrease is chiefly in the diffusible fraction.

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It is stated that tropical ulcer cannot be produced by experimental inoculation of the characteristic organisms unless an artificial necrosis of the skin is first produced. (Blanchard, 1914 ; Breinl, 1915.) It does not occur in Europeans, according to Edge (1921), except where the diet is restricted. It would be of the greatest interest to know whether it could be experimentally produced by inoculation of the organisms into animals in which the composition of the blood had first been altered by feeding an ill-balanced, high phosphorus, low calcium diet.

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Ka 164 146 In the absence of further information, it can only be said that the results of this investigation suggest that susceptibility to ulcer, which appears to be general amongst natives on ill-balanced diets of the type mentioned, is correlated with a high blood inorganic phosphate, occurring with a normal, or slightly subnormal calcium, and that the actual occurrence of ulcer is associated with an exaggeration of this abnormality.

IV.—SUMMARY OF RESULTS.

M K 146 164 Preliminary observations and a review of existing information suggested that disease is more prevalent amongst native races than is generally supposed, and indicated that the incidence of certain diseases might be correlated with diet.

A survey of two tribes, the Masai and Akikuyu, showed that the diet of the former consisted to a large extent of milk, meat and raw blood, and that of the latter mainly of cereals, roots and fruits, the bulk of the diet being cereals. The outstanding points of difference in chemical composition of the two diets were that the Masai have a relatively very high intake of protein, fat and calcium, while the Kikuyu have a high intake of carbohydrate and a low one of calcium. M K [262] Differences were found in the dietary customs between men and women in both tribes, the diets of the females approaching in each case to the mean between the diets of the males.

M K [141] Physical measurements showed that the full-grown Masai male is on an average, 5 inches taller and 23 lb. heavier than the full-grown male Kikuyu, and his muscular strength, as determined by the dynamometer, is 50 per cent. greater. Marked differences were found in the incidence of disease in the two tribes, bony deformities, dental caries and anæmia, pulmonary conditions and tropical ulcer being much more prevalent amongst the Akikuyu. On the other hand, intestinal stasis and rheumatoid arthritis were more common amongst the Masai.

Ka [146] Analyses showed that routine Hospital and Prison diets are markedly deficient in calcium, the average daily intake being only about 0·3 gm. Ca, as compared with the assessed requirement of about 1 gm.

K Ka 147 Examination of the blood of Kikuyu and other natives on a similar dietary showed that the concentration of calcium was lower than the European standard, the average of 90 cases, prisoners and farm labourers (not pathological) being 9·4 mg. per 100 c.c. serum, as compared with 10·0 to 10·5 mg. in Europeans at home, and 11·4 mg. in 13 Europeans in Kenya. The range of variation in blood calcium was wide, from 7·3 mg. to 11·2 mg., the highest figure being below the mean for Europeans in Kenya.

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Kikuyu FL10
Kenya FL1

Additions of calcium salts, cod liver oil and milk made to the routine prison diets were followed by an increased retention of calcium varying from about 0·15 to 0·64 gm., the highest retention being procured in the case of calcium salts and milk. Cod liver oil had no definite effect on the calcium balances. In the adult subjects receiving additional calcium or cod liver oil in the diet, the percentage of calcium in the blood was increased. Ka 146 125

A description of tropical ulcer, as it occurs in Kenya, is given. Ka 164 A study of the etiology of this condition showed that its occurrence could not be correlated with the presence of syphilis or malaria, nor was there any definite correlation with intestinal parasitic infestation. Examination of the blood showed that the main difference between ulcer and non-ulcer cases was in the blood Ka [147] inorganic phosphorus, which was abnormally high in ulcer cases, distinctly above the level of non-ulcer cases, which themselves showed a higher level than Europeans at home or in Kenya. Thus the ulcer cases showed a marked exaggeration of a tendency common to all the natives examined. Dietetic treatment of ulcer cases gave no definite result. As the state of nutrition of the patient improved the ulcer tended to heal more quickly, but no outstanding effect could be attributed to any of the supplements tried, *e.g.*, minerals, cod liver oil, milk or tomatoes.

A short feeding experiment was arranged at a Reformatory and carried out under the supervision of the Superintendent, observations being made on the rate of increase in height and weight. A distinctly increased rate of growth was obtained by addition of maize alone, maize and bone meal, or milk, to the routine diet, the rate of increase in height being from 30 to 40 per cent. greater than in the control group on the routine diet. The feeding of bone meal with the maize caused an improvement in rate of increase (2·6 per cent.) amongst the younger boys, but none taking all the boys together. Indeed the height increase on a supplement of maize alone was greater than with added bone meal. Unfortunately, arrangements for feeding experiments with larger groups over longer periods could not be carried through. Ka 146 125

At the present stage we should not feel justified in attempting a detailed discussion of the results obtained or in attempting to draw definite conclusions therefrom. There is, however, in our view, ground for the following observations :—

The striking difference in physique between the Masai and Akikuyu raises the question to what extent diet can affect the stature and physique of a race. In Scottish experiments with school children it was found that the feeding of milk was followed by increased rate of growth in two successive years with the same children, but there was nothing to show whether this increase represented merely acceleration of growth with a shortening of the growth period, or M K 146

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M K 146 whether, if the milk had been continued, there would have been a difference in adult stature. The results of the measurements of the Kikuyu and Masai at first sight suggests the latter alternative. But, M K [149] although there has been a good deal of intermarriage between the two tribes, they were originally of different stock, and we have no information as to whether, or to what extent the differences in stature and physique may be inherited characters. It would be an interesting study to correlate diet and stature in different countries, to ascertain whether any correlation exists between the quality of the diet and mean adult stature.

M K 164 146 There are differences in the incidence of disease in the two tribes, and one of the tribes, the Akikuyu, show abnormalities in the K [149] composition of the blood. The diet of this tribe is very rich in carbohydrate, relatively rich in phosphorus, but deficient in calcium. Experimental data have been brought forward to lend support to the suggestion that deficiencies in the diet, abnormal composition of the blood and reduced susceptibility to certain diseases which have been noted in this tribe, may be correlated. The possibility that diet may influence the susceptibility to certain infectious diseases raises one of the most important problems in nutritional research.

M Ka 146 With regard to the bearing of the results of the investigation on conditions in Kenya, we are probably justified in concluding that the diet commonly in use amongst the Akikuyu and other tribes of similar customs is badly balanced, being too rich in carbohydrate and deficient in calcium. It is probably deficient also in other substances required as constructive material for growth, and in certain of the vitamins. On the other hand, the Masai, with a diet at the opposite extreme, possibly have too little vegetable food rich in carbohydrate and cellulose. Improvement might be brought about by increasing the use of green vegetables by both tribes, and of milk by the Akikuyu.

000 The problem is therefore one which concerns not only medical and public health, but also agricultural authorities. A general improvement of agriculture and animal husbandry amongst the Akikuyu will almost certainly be accompanied by an improvement in the health and working capacity of the natives themselves.

This problem is not confined to Kenya. It appears to exist in many different areas in our tropical dependencies. It may be judged from the introductory statements in the early part of this report that the loss of health and efficiency attributable to deficient diet is, therefore, of considerable economic importance.

V.—CONCLUSIONS.

1. In view of the great practical importance of the subject studied OUD and the extreme difficulty of the associated problems, some of which are, indeed, of a fundamental nature, it is impossible to regard these investigations as more than a series of preliminary observations. They lie, however, in a field of research, which, in our opinion, urgently calls for both intensive study and extensive exploration.

2. These investigations, which were promoted by the Empire Marketing Board, have no immediate bearing on the increased production or better marketing of any particular product. But information obtained in investigations of this kind is calculated to hasten the improvement of the physical condition of the native and to increase his importance as an economic factor. From this material point of view alone the continuation of research on the nutritional conditions of natives is justified. The Empire Marketing Board has shown foresight in promoting such long-range research, which tends to the development of those overseas parts of the Empire with a large native population.

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REFERENCES.

Addams and Hamilton, 1919: *Brit. J. Child. Dis.*, **16**, 129.
Anderson, G. V., 1929: *Kenya Med. J.*, **6**, 62.
Anderson, T. F., 1929: *Kenya Med. J.*, **6**, 2.
Ann. Med. Rep. Colony and Protectorate of Kenya, 1923, 53.
Ann. Med. Rep. Colony and Protectorate of Kenya, 1927, 6.
Ashford and Hernandez, 1926: *Amer. J. Med. Sci.*, **171**, 875.
Beery and Hayes, 1926: *J. Amer. Med. Assn.*, **87**, 1002.
Bhatia and Coelho, 1925: *Indian J. Med. Res.*, **13**, 41.
Blanchard, 1914: *Bull. Soc. Path. Exot.*, **7**, 96.
Boedeker, 1924: *Ann. Med. Rep. Colony and Protectorate of Kenya*, 22.
Breinl, 1915: *Ann. Trop. Med.*, **9**, 265.
Breinl and Young, 1919-20: *Ann. Trop. Med.*, **13**, 331.
Brennan, 1926: *Kenya Med. J.*, **3**, 261.
Briscoe, 1929: *Kenya Med. J.*, **6**, 175.
Callanan, 1926: *Kenya Med. J.*, **3**, 62.
Callanan, 1927: *Kenya Med. J.*, **4**, 103.
Cathcart and Orr, 1919: "Energy Expenditure of Infantry Recruit in Training" (H.M.S.O.).
Cilento, 1926: *Med. J. Australia*, ii, 309.
Denis and Minot, 1920: *J. Biol. Chem.*, **41**, 357.
Edge, 1921: *Lancet*, i, 1327.
Fisher, 1923: *Ann. Med. Rep. Colony and Protectorate of Kenya*, 25.
Fisher, 1924: *Ann. Med. Rep. Colony and Protectorate of Kenya*, 29
Fleming, 1924: *J. Metabol. Res.*, **6**, 87.
Greenwald and Gross, 1925: *J. Biol. Chem.*, **66**, 217.
Halpin, 1918: *U.S. Nav. Med. Bull.*, **12**, 80.
Harvey, 1929: *Kenya Med. J.*, **6**, 191.
James, 1929: *Kenya Med. J.*, **6**, 92.
Kahn and Roe, 1926: *J. Amer. Med. Assn.*, **86**, 1761.
Kay and Byrom, 1927: *Brit. J. Exp. Path.*, **8**, 240.
Kramer and Howland, 1922: *Johns Hopkins Hosp. Bull.*, **33**, 313.
Leighton and Clark, 1929: *Lancet*, i, 40.
Lusk, 1921: *The Science of Nutrition.*
McCulloch, 1929: *Thesis, Aberdeen.*
MacLean, 1924: "Modern Methods in the Diagnosis and Treatment of Renal Disease" (London).
Magee and Harvey, 1926: *Biochem. J.*, **20**, 885.
Mei, 1930: *J. Trop. Med. and Hyg.*, **33**, 28.
Mendelson, 1918: *Med. J. Siamese Red Cross*, **1**, Pt. 1, 43.
Orr, 1924: *Veterinary Record*, **4**, 943.
Orr, 1926: *Lancet*, i, 202.
Orr, 1930: *Trans. Highland and Agri. Soc.*, **42**, 19.
Park, Guy and Powers, 1923: *Am. J. Dis. Child.*, **26**, 103.
Philip, 1927 (1): *Kenya Med. J.*, **4**, 230.
Philip, 1927 (2): *Kenya Med. J.*, **4**, 267.
Richards, 1926: *Biochem. J.*, **20**, 1272.
Robinson and Huffman, 1926: *J. Biol. Chem.*, **67**, 245.
Roddis and Cooper, 1926: *J. Amer. Med. Assn.*, **87**, 2053.
Ross, 1929: *Kenya Med. J.*, **5**, 367.
Schabad and Sorochowitsch, 1911: *Monatschr. f. Kinderheilk.*, **10**, 12.
Schloss, 1913: *Jahrb. f. Kinderheilk.* (3rd Ser., 28), **78**, 694
Sherman, 1920: *J. Biol. Chem.*, **44**, 21.
Sherman, 1926: *Chemistry of Food and Nutrition.*
Sherman and Hawley, 1922: *J. Biol. Chem.*, **53**, 375.
Sherman and MacLeod, 1925: *J. Biol. Chem.*, **64**, 429.
Stitt, 1929: *The Diagnosis and Treatment of Tropical Diseases* (London).
Strong, 1927: *Med. J. Australia*, i, 607.
Tate, 1917-18: *Kikuyu Province Annual Report* (unpublished).
Tocher, 1925: "Variations in the Composition of Milk" (H.M.S.O.).
Vint, 1929: *Kenya Med. J.*, **5**, 362.
Wilson, 1929: *Kenya Med. J.*, **6**, 296

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APPENDIX I.

CHEMICAL COMPOSITION OF FOODSTUFFS.

REPORT BY W. GODDEN.

The results are given below of the analysis of 153 samples of materials used in one form or another in the native dietary. These are classified as follows:—

	No. of samples.
Foodstuffs	[illegible]
Leaves of trees and shrubs	[illegible]
Plant ashes	4
Edible earths	[illegible]
Milks	[illegible]
Mineral waters	[illegible]

In addition, there were 17 samples of pasture and three of soil taken from the land grazed by the cows, from which the milk samples were obtained.

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TABLE I—*Foodstuffs.*

Percentages in Dry Matter.

Foodstuffs.	Nitrogen.	Total ash.	Acid sol. ash.	Calcium.	Sodium.	Potassium.	Phosphorus.	Chlorine.
	%	%	%	%	%	%	%	%
Beans—								
Average of 5 samples ..	4·00	3·88	3·85	0·11	0·042	1·52	0·45	0·02
Range	3·48–4·28	3·44–4·27	3·30–4·20	0·07–0·15	0·031–0·056	1·30–1·65	0·33–0·55	0·01–0·03
Cassava, 1 sample	0·75	5·00	4·91	0·16	0·035	1·60	0·10	0·04
Maize, 1 sample	1·60	1·59	1·58	0·005	0·030	0·42	0·41	0·03
Marrow, 1 sample	1·11	6·73	6·56	0·19	0·015	2·92	0·30	0·27
Matuya fruit, 1 sample ..	1·29	5·75	5·53	0·45	0·131	1·62	0·15	0·38
Millet, red—								
Average of 3 samples ..	1·33	3·58	3·31	0·29	0·004	0·71	0·33	0·15
Range	1·27–1·38	3·41–3·76	3·26–3·35	0·16–0·42	Trace–0·010	0·56–0·83	0·30–0·34	0·12–0·21
Millet, white—								
Average of 6 samples ..	1·86	2·26	1·83	0·02	0·013	0·47	0·36	0·09
Range	1·50–2·86	1·70–2·72	1·44–2·03	0·014–0·031	Trace–0·021	0·39–0·56	0·28–0·41	0·03–0·15
Ndoma, arrowroot—								
Average of 6 samples ..	0·98	6·56	6·52	0·47	0·013	2·98	0·15	0·38
Range	0·49–2·87	3·86–13·33	3·84–13·28	0·19–1·02	0·003–0·030	1·41–6·26	0·09–0·30	0·02–0·81
Ngambura fruit, 1 sample ..	2·27	13·49	13·28	0·63	0·026	4·03	0·80	0·33
Plantains and bananas—								
Average of 17 samples ..	0·74	4·00	4·03	0·02	0·043	1·83	0·14	0·27
Range	0·46–1·08	3·10–5·35	3·06–5·35	0·01–0·04	Trace–0·097	1·20–2·45	0·10–0·22	0·19–0·34
Kippered bananas, 1 sample ..	0·84	5·84	5·09	0·23	0·103	1·88	0·14	0·26
Peas—								
Average of 4 samples ..	3·93	3·83	3·80	0·10	0·042	1·53	0·43	0·03
Range	3·70–4·55	3·29–4·60	3·18–4·52	0·07–0·12	0·019–0·062	1·31–1·80	0·27–0·63	0·01–0·05

14:Orr & Gilks D-4 (no date) 1931 FL.12 Masai FL12
Kikuyu FL10
Kenya F&1.

TABLE I.—*Foodstuffs*—*cont.*

Percentages in Dry Matter.

Foodstuffs.	Nitrogen.	Total ash.	Acid sol. ash.	Calcium.	Sodium.	Potassium.	Phosphorus.	Chlorine.
	%	%	%	%	%	%	%	%
Potatoes, European—								
Average of 3 samples ..	1·45	5·55	5·47	0·05	0·014	2·38	0·23	0·12
Range	1·34–1·56	4·43–6·65	4·43–6·45	0·04–0·07	Trace–0·033	2·03–2·68	0·20–0·26	0·09–0·15
Potatoes, sweet—								
Average of 17 samples ..	0·53	3·43	3·34	0·09	0·036	1·41	0·15	0·18
Range	0·34–0·66	2·20–4·45	2·10–4·43	0·02–0·16	Trace–0·101	0·87–2·09	0·10–0·29	0·11–0·38
Sugar cane—								
Average 2 samples	0·25	2·09	1·52	0·10	0·024	0·69	0·06	0·06
Range	0·21–0·28	1·96–2·23	1·27–1·77	0·09–0·11	—	—	0·04–0·08	—
Yams—								
Average of 6 samples ..	1·16	2·52	2·50	0·02	0·016	1·16	0·09	0·02
Range	0·96–1·26	1·49–2·95	1·48–2·92	Trace–0·05	Trace–0·044	0·60–1·53	0·06–0·10	0·01–0·05
Cooked Foods.								
Irio—								
Average of 2 samples ..	2·30	4·09	4·02	0·24	0·150	1·24	0·30	0·28
Range	2·05–2·56	3·56–4·62	3·48–4·59	0·24–0·25	0·030–0·270	1·08–1·40	0·27–0·34	0·10–0·46
Kiruyu, 1 sample	2·29	3·08	2·61	0·06	0·217	0·46	0·32	0·13
Mutlio, 1 sample	2·38	2·66	2·25	0·04	0·157	0·40	0·34	0·11
Ucuru, 1 sample..	1·94	2·53	2·25	0·03	0·043	0·52	0·38	0·06
Mucuru—								
Average of 2 samples ..	2·63	4·08	4·06	0·13	0·253	0·96	0·30	0·11
Range	2·58–2·68	3·81–4·35	3·77–4·35	0·10–0·15	0·151–0·355	0·83–1·09	0·26–0·35	0·11–0·12
Ngondi, 1 sample	11·56	6·24	6·17	0·31	1·611	0·93	0·29	0·16

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

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Foodstuffs.

In Table I the results of the analysis of the 83 samples of foodstuffs are summarised. Where a number of samples of the same substance were received, the average figures and the range are given, all percentages being expressed on the dry matter and in terms of the particular element estimated. In many cases different varieties of the same species of plant were submitted, and certain points may be noted with regard to varietal differences.

Thus, amongst the millets, the three samples of the variety, Mugimbi, submitted, were all richer in ash, calcium, potassium and chlorine, and poorer in sodium, phosphorus and nitrogen, than the average for all the millets, whilst for the three samples of the variety, Mwele, the exact reverse was found. A further difference between the two varieties is shown in the manganese content (*vide* Table II), that of Mugimbi being =40·19 mgms. per 100 gms., whereas that of Mwele is only 2·55. Mugimbi is a red millet, Mwele a white millet.

Twelve different varieties are represented in the figures for plantains, but there do not appear to be any outstanding differences in the composition of the different varieties.

The results for European potatoes cover three varieties, and those for sweet potatoes fifteen varieties. In neither case does any one variety stand out from the rest, although there is a fairly wide range of variation between the extremes. The five different varieties of yams also agree amongst themselves fairly closely.

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The cooked Kikuyu foods show a fair amount of difference amongst themselves, owing to differences in the materials used for compounding them. In the case of Irio, for example, the calcium content is high as compared with all the others, probably owing to the fact that Hatha leaves are incorporated to the extent of roughly one part in eight of the mixture. Ucuru, on the other hand, which consists simply of millet flour, is one of the poorest in mineral content. Ngondi, which is a Masai food, differs from all the Kikuyu foods, in that its ingredients, namely, blood, milk and some fat, are all of animal origin. Its outstanding difference from the other cooked foods is its high nitrogen content.

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TABLE II.—*Manganese Content of Foodstuffs, etc.*

(*Expressed as mgms. of Mn in 100 gms. Dry Matter*).

Foodstuff.	*Mn content.*
Bean	2·36
Maize	0·70
Marrow	2·49
Millet (white)	2·55
„ (red)	40·19
Pea	2·51
Plantain	1·88
Potatoes (sweet)	2·78
Yam	0·20
Cooked Foods.	
Irio	3·51
Kireyu	4·54
Mathio	3·84
Mukiro	4·03
Musura	4·70
Ngondi	0·40

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

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	Mn content.
Leaves.	
Hatha	41·72
Maboco	28·63
Managu	29·36
Mathoroko	51·31
Muyuyu	30·16
Terere	8·93
Togotia	20·06
Plant Ash.	
Mararia	418·0
Marura	352·0
Edible Earths.	
Kimana	44·26
S. of Manga (Ol Dugai)	15·13

A number of the foodstuffs, selected on the advice of Dr. Foster, were examined for manganese. The results are shown in Table II. Apart from the high figure recorded for the red variety of millet, Mugimbi, and green leaves, the foodstuffs show nothing marked as regards their manganese content. It is of interest to note that, of the cooked foods, Ngondi, of animal origin, is much lower than the others, which are all made from vegetable material.

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TABLE III.—*Green Leaves of Trees and Shrubs.*

Percentages in Dry Matter.

Name of Leaf.	Nitrogen.	Total ash.	Acid sol. ash.	Calcium.	Sodium.	Potassium.	Phosphorus.	Chlorine.
	%	%	%	%	%	%	%	%
Hatha or Hassa, 1 sample	5·11	20·47	19·80	4·52	Trace	3·24	0·46	0·42
Kalema Ka Ndia, 1 sample ..	5·73	14·25	13·48	2·61	0·061	2·29	0·41	0·30
Maboco, 1 sample	4·56	18·45	17·04	3·31	0·086	4·32	0·52	0·55
Managu, 1 sample	5·11	13·71	13·26	2·43	0·148	2·96	0·44	1·95
Marenge—								
Average of 3 samples	5·45	24·34	23·16	1·74	0·343	5·20	1·02	0·51
Range	4·94–6·47	13·53–29·13	13·20–27·58	1·07–1·91	0·057–1·10	4·51–5·50	0·97–1·19	0·47–0·69
Mathoroko—								
Average of 3 samples	4·49	15·81	14·54	3·74	0·056	2·63	0·37	0·30
Range	4·36–4·97	14·59–22·79	13·08–21·97	2·74–4·57	0·035–0·114	2·15–3·02	0·27–0·66	0·20–0·61
Muyuyu, 1 sample	5·01	25·19	25·16	0·85	0·017	10·64	0·34	0·49
Ndoma, 1 sample	5·51	17·52	17·47	2·64	0·095	4·14	0·90	1·24
Terere—								
Average of 4 samples	4·29	23·06	22·59	2·56	0·106	5·73	0·70	0·53
Range	3·81–4·69	16·55–32·77	16·34–31·97	1·67–3·60	Trace–0·185	3·23–7·74	0·48–1·06	0·38–0·68
Togotia—								
Average of 2 samples	5·15	24·62	23·67	3·46	0·166	5·99	0·65	0·64
Range	4·91–5·77	17·30–27·57	16·85–26·42	2·95–3·67	0·117–0·187	3·67–6·95	0·43–0·74	0·53–0·90
Average of 18 samples	4·92	21·11	20·38	2·66	0·131	5·35	0·63	0·63
Range	3·81–6·47	13·53–32·77	13·08–31·97	0·85–4·57	Trace–1·10	2·15–10·64	0·27–1·19	0·20–1·95

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

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As compared with the other vegetable foodstuffs, the leaves stand out as being high in nitrogen, total and soluble ash, and in calcium, and they are appreciably higher in chlorine. The incorporation of these materials in the mixed cooked foods thus tends to make up for the marked deficiency of calcium, which occurs in all of the simple foodstuffs used by the natives. These calcium figures all appear as high even when compared with the recorded data for such material as alfalfa (1·26 per cent.); red clover (1·07 per cent.) and the highest figure obtained for a highly cultivated British pasture (1·76 per cent.). Three samples of leaves stand out from the remainder, namely, Hatha leaves, and one sample of Mathoroko leaves, with a calcium content of 4·5 per cent. against an average of 2·66 per cent. for the 18 samples, and Muyuyu leaves, which are comparatively low in calcium 0·85 per cent., but exceptionally high in potassium, 10·64 per cent., against an average figure of 5·35 per cent.

TABLE IV.—*Plant Ashes and Extracts.*

	Percentages in Dry Matter.			*Grams per litre.*
	Mararia.	Marura.		Aqueous extract of Itatema root.
	1 sample.	Aver. of six samples.	Range.	
	Per cent.	Per cent.	Per cent.	
Nitrogen ..	0·52	0·16	0·06– 0·45	0·05
Total Ash ..	76·51	86·32	57·77–96·19	2·01
Acid Sol. Ash ..	50·22	39·66	26·86–74·93	2·01
Calcium ..	5·23	3·11	1·07–10·60	0·10
Sodium ..	5·09	7·65	3·43–10·27	0·41
Potassium ..	10·47	3·13	1·61– 5·34	0·58
Phosphorus ..	1·18	0·92	0·51– 1·15	0·02
Chlorine ..	9·62	7·10	3·35–10·89	0·04
Manganese .. (mgrs. per 100 grs.)	418·0	352·0	—	0·016

Note.—Under Marura, there is one sample, namely that which was obtained at Wandiga's market, which stands out from all the others with a calcium content of 10·60 per cent. The other five are all of the order 1·0–1·5 per cent.

Two types of plant ash were submitted, namely, Mararia, the ash of a swamp reed, and Marura, the ash of a papyrus plant. The former is considerably richer than the latter in calcium, potassium, and chlorine. One of the samples of Marura ash is very much lower in both sodium and chlorine than the other five, but this is probably due to the fact that the particular sample was by no means so completely burnt as the others. Considerable variations may, therefore, be expected in this type of material, due to the conditions of ashing by the native. These materials will make up to some extent for the low calcium and sodium content of the foodstuffs, if added to them during cooking.

Itatema is a short, reedy, swamp plant and the aqueous extract used by the natives, as supplied, was "an infusion of the entire sod, including adherent earth," and contained 2·83 gs. of total solids per litre.

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14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL16
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TABLE V.—*Edible Earths.*

Percentages in Dry Matter.

Area.	Source.	Nitrogen.	Total ash.	Acid sol. ash.	Calcium.	Sodium	Potassium.	Phosphorus.	Chlorine.	Iron.
Kikuyu Reserve :		%	%	%	%	%	%	%	%	%
Nyeri Area ..	Mwanamweru	0·26	90·98	21·08	0·30	0·76	0·29	0·02	0·06	5·64
	Iruri	0·40	87·73	26·96	0·29	0·08	0·32	0·04	0·11	9·30
	Kasuini	0·09	92·48	24·06	0·06	0·35	1·03	0·01	0·19	7·41
	Keru (Fort Hall)	—	89·96	31·58	0·09	0·04	0·16	0·12	—	14·02
	Njengu (Nyeri)	0·06	92·28	29·14	0·37	0·27	0·12	Trace	0·39	12·99
West of Nyeri ..	Lake Naivasha	0·10	92·21	18·77	0·34	4·67	0·21	0·03	0·16	2·80
Nyeri Area ..	Gitirikani	0·13	94·01	23·01	1·38	1·06	0·52	0·04	0·08	4·63
	Gatondu	0·13	92·61	37·32	0·25	0·24	0·15	Trace	0·08	12·67
Fort Hall Area ..	Murao (Kinyagati)	0·08	90·90	29·40	0·48	6·35	0·11	Trace	0·15	6·40
	Kaharati (Munyuangombe) ..	0·51	79·82	39·21	0·77	5·88	0·47	Trace	0·18	11·83
Masai Reserve : ..										
	Kimana	0·10	96·84	83·96	1·04	23·85	0·33	0·05	3·78	2·00
	S. of Manga (Ol Dugai) ..	0·21	90·40	82·95	0·88	30·15	4·52	0·30	0·84	0·48
	Kima	0·02	97·04	6·08	0·50	0·53	0·13	Trace	0·61	2·96
	Ol Donyorasha	0·09	91·61	47·20	2·56	14·76	1·45	0·05	0·76	1·35
	Near R. Siyabei	0·04	92·41	31·80	0·31	9·88	0·66	0·02	0·38	2·58
	Average of 15 samples ..	0·15	91·55	35·50	0·64	6·59	0·70	0·05	0·52	6·47
	Magadi soda	0·03	98·84	98·84	0·07	42·53	0·46	0·01	0·44	0·15

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10
Kenya FL1

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As might be expected from the nature of the material, the edible earths show considerable variation according to the area from which they are obtained. On the whole, the two elements which occur in the highest amount in these substances are sodium and iron. At the same time, they have a much higher percentage of calcium than phosphorus, the reverse of what the foodstuffs show. The majority of the edible earths are heavily loaded up with silica, the average percentage of ash insoluble in acid being 56 per cent. of the dry matter. Two of the edible earths, namely, that from Kimana, and the one, Ol Dugai, from a special part of the desert, south of the Manga–Laitokitok road, would make fair substitutes for Magadi soda, by virtue of their sodium content.

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TABLE VI.—*Milks.*

	Per 100 c.c.			Per 1,000 calories.	
	Kenya.		British.	Kenya.	British.
	Av. of 13 samples.	Range.	Average.		
Total solids ..	13·77	12·53–15·28	12·89		
Nitrogen ..	0·569	0·489–0·668	0·540		
Sugar	4·92	3·69–5·61	4·80		
Fat	5·48	4·45–8·06	3·90		
Ash	0·729	0·657–0·773	0·754	8·28	10·77
Calcium ..	0·129	0·104–0·149	0·119	1·47	1·70
Sodium.. ..	0·037	0·029–0·046	0·056	0·42	0·80
Potassium ..	0·143	0·131–0·158	0·168	1·62	2·40
Phosphorous ..	0·095	0·079–0·107	0·100	1·08	1·42
Chlorine ..	0·095	0·072–0·126	0·111	1·08	1·58
Iron	0·00008	·00006–0·00015	0·00009	0·0009	0·0014

The Kenya milks are, on the average, richer in protein, fat and sugar than British samples, but poorer in ash and all its constituents with the exception of calcium. This poverty is accentuated if the comparison is made on the basis of 1,000 calories as supplied by the milk and then the Kenya milk shows up as deficient in calcium.

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Bearing in mind that the milk yield of the native cows is as a rule very low, (100–150 gallons per annum), on the basis of Dr. Tocher's figures for variation in the composition of milk, it would have been reasonable to expect the Kenya milk to be richer in fat, protein and ash than the British, but poorer in sugar. This is actually true for the fat and protein, but not for the ash and sugar. Similarly certain results, as yet unpublished, obtained at the Rowett Institute, indicate that with a low milk yield, the calcium, potassium and phosphorus percentages might be expected to be low, but the sodium and chlorine high. The results for calcium, sodium and chlorine do not agree with this expectation.

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TABLE VII.—*Pastures Grazed by Milch Cows.*

Percentages in Dry Matter.

	Average of 17 samples. Per cent.	Range. Per cent.
Nitrogen	0·59 ..	0·37– 1·09
Total ash	9·61 ..	6·92–13·51
Acid sol. ash	2·48 ..	1·40– 4·32
Calcium	0·28 ..	0·15– 0·51
Sodium	0·06 ..	0·02– 0·27
Potassium	0·61 ..	0·24– 1·10
Phosphorus	0·11 ..	0·01– 0·24
Chlorine	0·21 ..	0·07– 0·49

146 The composition of the herbage upon which the cows were grazing would
137 appear to offer an explanation both of the low yield of milk and the low
mineral content of the milk. An examination of the figures in Table VII
233 shows that the herbage is very poor in nitrogen and all mineral constituents as compared with the average for British cultivated grass, and, on the whole, it would appear to be poorer than the herbage at the experimental centre at Molo, where positive results were obtained by supplementary feeding with minerals and protein. The soils underlying the pastures are deficient in lime and total and available phosphate, but reasonably well supplied with potash.

Mineral Waters.

312 Fifteen samples of water were received, but the volume of the samples allowed of the estimation only of total solids and the calcium content. The
146 results are given in Table VIII, in which, for comparison, the results for four types of British waters are included. On the whole, the waters contain a larger amount of total solids, mostly dissolved, than the British waters. One or two very high figures are due to suspended earthy material in the water. One of two of the samples are fairly high in calcium and effervesce with acid.

TABLE VIII.—*Mineral Waters.*

Parts per 100,000.

	Total solids.	Calcium.
Kenya—		
Average of 15 samples	722·4	9·83
Range	63·0–6917	0·70–43·60
British—		
Upland surface	7·8	0·92
Deep well	19·4	5·28
Shallow well	69·5	15·52
River Trent	55·4	14·00

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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APPENDIX II.

TABLE I.

Heights and Weights—Kikuyu and Masai Males.

Kikuyu Males.				Masai Males.			
Age.	No.	Average height. Inches.	Average weight. lbs.	No.	Average height. Inches.	Average weight. lbs.	Age.
2	8	34·6	23·5	—	—	—	2
3	15	37·7	27·3	9	35·2	[illegible]	3
4	23	40·8	32·5	14	38·7	[illegible]	4
5	24	41·7	34·3	12	41·9	[illegible]	5
6	30	44·5	38·2	12	45·8	[illegible]	6
7	54	46·5	43·2	14	[illegible]	[illegible]	7
8	80	47·2	44·8	13	[illegible]	52·8	8
9	93	50·0	51·1	18	53·3	59·1	9
10	95	51·9	55·9	18	53·6	61·0	10
11	79	53·4	60·6	18	55·1	66·2	11
12	91	54·2	63·0	24	56·7	69·8	12
13	63	55·9	67·7	18	57·9	74·6	13
14	56	58·5	75·7	20	60·6	83·3	14
15	63	60·4	85·2	19	63·4	94·7	15
16	86	61·7	93·5	9	65·2	107·3	16
17–18	130	63·1	105·0	17	67·2	119·2	17–18
19–20	175	64·4	110·6	32	69·0	133·3	19–20
21–25	423	64·9	114·9	88	67·8	133·7	21–25
26–30	436	64·8	114·2	76	67·7	134·8	26–30
31–40	412	64·4	109·9	166	67·4	130·5	31–40

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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TABLE II.

Heights and Weights—Kikuyu and Masai Females.

Kikuyu Females.				Masai Females.			
Age.	No.	Average height Inches.	Average weight lbs.	No.	Average height Inches.	Average weight lbs.	Age.
2	12	35·5	23·6	—	—	—	2
3	13	36·9	26·8	6	36·0	25·7	3
4	11	38·6	31·3	6	38·7	31·3	4
5	24	42·9	35·5	9	40·5	32·6	5
6	39	45·2	41·9	17	43·6	37·9	6
7	35	46·9	43·5	13	45·8	42·5	7
8	42	47·7	46·6	12	48·5	50·1	8
9	42	49·2	48·7	18	50·0	52·2	9
10	52	50·0	53·5	14	52·9	64·4	10
11	60	52·0	57·2	17	54·1	64·4	11
12	48	53·2	62·1	11	56·2	71·3	12
13	49	54·7	66·2	9	56·9	73·1	13
14	29	56·5	72·7	8	58·8	82·6	14
15	47	57·8	78·9	9	61·5	104·6	15
16	51	58·9	85·5	11	61·8	103·0	16
17–18	254	59·4	92·1	16	62·1	114·2	17–18
19–20	397	59·7	94·1	41	62·7	119·6	19–20
21–25	441	60·2	100·6	99	62·6	127·4	21–25
26–30	188	60·2	99·9	61	61·8	117·9	26–30
31–40	100	59·7	94·2	132	61·8	112·8	31–40

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TABLE III.

Average Dynamometer Records—Males.

Kikuyu Males.			Masai Males.		
Age.	No.	Dyn. record.	No.	Dyn. record.	Age.
Years.		lb.		lb.	Years.
6	17	18·2	6	22·0	6
7	47	22·5	11	29·3	7
8	82	24·4	11	27·6	8
9	96	28·0	18	35·2	9
10	94	30·0	17	39·6	10
11	79	33·0	18	40·0	11
12	91	34·1	24	40·9	12
13	89	37·9	18	46·1	13
14	58	41·6	20	52·9	14
15	65	46·0	19	58·5	15
16	80	48·2	9	60·3	16
20	100	58·1	29	66·8	20
21–25	150	58·7	90	67·7	21–25

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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TABLE IV.

Average Dynamometer Records—Females.

Kikuyu Females.			Masai Females.		
Age.	No.	Dyn. record.	No.	Dyn. record.	Age.
Years.		lbs.		lbs.	Years.
6	24	22·3	2	22·5	6
7	25	23·1	5	19·6	7
8	34	24·8	12	24·5	8
9	40	24·3	16	28·0	9
10	50	27·2	14	33·6	10
11	61	29·5	17	34·6	11
12	49	30·5	11	39·0	12
13	48	35·7	9	38·1	13
14	31	37·3	8	42·0	14
15	46	37·8	9	49·4	15
16	40	38·1	11	45·4	16
20	92	46·0	44	56·6	20
21–25	100	49·2	99	59·1	21–25

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TABLE V

Average Measurements of Chest and Abdomen in Kikuyu and Masai Males.

Kikuyu Males.				Masai Males.			
Age.	No.	Chest.	Abdomen.	No.	Chest.	Abdomen.	Age.
Years.		Inches.	Inches.		Inches.	Inches.	Years.
6	33	21·6	21·1	4	22·6	21·2	6
7	54	22·8	22·1	10	24·3	21·9	7
8	82	23·6	22·8	4	24·5	23·0	8
9	97	24·3	23·0	11	25·6	22·6	9
10	95	25·0	23·5	13	25·2	22·7	10
11	79	25·5	23·8	14	26·0	22·6	11
12	91	26·1	24·3	22	25·9	22·8	12
13	59	26·6	24·6	18	27·3	23·7	13
14	56	27·7	25·4	19	28·1	24·8	14
15	43	28·9	26·2	16	29·5	25·5	15
16	80	29·8	27·0	7	31·4	27·1	16
21–25	130	32·1	28·7	45	34·3	29·6	21–25

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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TABLE VI.

Average Measurements of Chest and Abdomen in Kikuyu and Masai Females.

Kikuyu Females.				Masai Females.			
Age.	No.	Chest.	Abdomen.	No.	Chest.	Abdomen.	Age.
Years.		Inches.	Inches.		Inches.	Inches.	Years.
6	40	22·5	21·8	4	21·4	20·7	6
7	38	22·4	21·9	4	22·4	20·1	7
8	41	22·8	22·2	6	22·9	21·9	8
9	43	23·4	22·2	9	23·7	21·6	9
10	51	24·2	22·8	4	25·8	22·9	10
11	61	24·7	23·5	10	25·7	22·9	11
12	49	25·6	24·1	6	26·1	23·4	12
13	48	25·9	24·4	8	25·7	23·3	13
14	31	27·2	25·2	5	28·9	23·8	14
15	46	28·3	25·6	5	28·4	24·5	15
16	49	29·2	26·0	10	30·1	26·3	16
21–25	100	31·0	28·7	70	32·7	29·0	21–25

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TABLE VII.

Condition of Kikuyu and Masai Children.

Age Group I.—Up to and including 7 years.

		Very Good.	Good.	Fair.	Poor.	Bad.	Very Bad.
Kikuyu boys—	Per cent.	7·3	16·4	32·4	29·8	12·2	1·9
No. examined ..	.. 262	19	43	85	78	32	5
Kikuyu girls—	Per cent.	28·8	30	23·9	13	3·7	0·6
No. examined ..	.. 347	100	104	83	45	13	2
Masai boys—	Per cent.	63·2	18·4	10·5	7·9	—	—
No. examined ..	.. 38	24	7	4	3	—	—
Masai girls—	Per cent.	66·7	23·1	10·2	—	—	—
No. examined ..	.. 39	26	9	4	—	—	—

Age Group II.—8–11 years.

		Very Good.	Good.	Fair.	Poor.	Bad.	Very Bad.
Kikuyu boys—	Per cent.	3·5	12·8	36·3	32·2	11·1	4·1
No. examined ..	.. 634	22	81	230	204	71	26
Kikuyu girls—	Per cent.	16·7	26·1	30·9	21·1	4	1·2
No. examined ..	.. 582	97	152	180	123	23	7
Masai boys—	Per cent.	47·4	26·3	15·8	10·5	—	—
No. examined ..	.. 19	9	5	3	2	—	—
Masai girls—	Per cent.	46·6	26·7	16·7	6·7	3·3	—
No. examined ..	.. 30	14	8	5	2	1	—

Age Group III.—12–16 years inclusive.

		Very Good.	Good.	Fair.	Poor.	Bad.	Very Bad.
Kikuyu boys—	Per cent.	9·1	17·4	35·6	24·4	10·7	2·8
No. examined ..	.. 430	39	75	153	105	46	12
Kikuyu girls—	Per cent.	24·9	33·1	25·3	12·7	2·9	1·2
No. examined ..	.. 245	61	81	62	31	7	3
Masai boys—	Per cent.	100	—	—	—	—	—
No. examined ..	.. 3	3	—	—	—	—	—
Masai girls—	Per cent.	38·5	46·2	7·7	7·7	—	—
No. examined ..	.. 13	5	6	1	1	—	—

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

TABLE VII.

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Table showing Percentage Incidence of Diseases in Children.

	Per cent.
(1) *Bone Abnormalities.*	
Kikuyu boys	65·4
Kikuyu girls	43·7
Masai boys	11·7
Masai girls	14·6
(2) *All Dental Defects.*	
Kikuyu boys	40·0
Kikuyu girls	28·6
Masai boys	8·3
Masai girls	7·3
(3) *Caries alone.*	
Kikuyu boys	13·7
Kikuyu girls	13·1
Masai boys	1·6
Masai girls	3·6
(4) *Spongy Gums.*	
Kikuyu boys	61·6
Kikuyu girls	52·6
Masai boys	15·6
Masai girls	22·0
(5) *Anaemia.*	
Kikuyu boys	47·8
Kikuyu girls	38·9
Masai boys	11·7
Masai girls	8·8
(6) *Enlarged Tonsils.*	
Kikuyu boys	88·0
Kikuyu girls	63·5
Masai boys	35·0
Masai girls	33·4
(7) *Cervical Adenitis.*	
Kikuyu boys	52·6
Kikuyu girls	47·4
Masai boys	40·0
Masai girls	29·8

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai
Kenya FL/

APPENDIX III.

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Sugar Tolerance Test on Natives and Europeans—50 g. Glucose.

Blood sugar; mgms. per 100 c.c.

No. of Prisoner.	Hours.				
	0	½	1	1½	2½
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Ulcer Cases.					
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[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]
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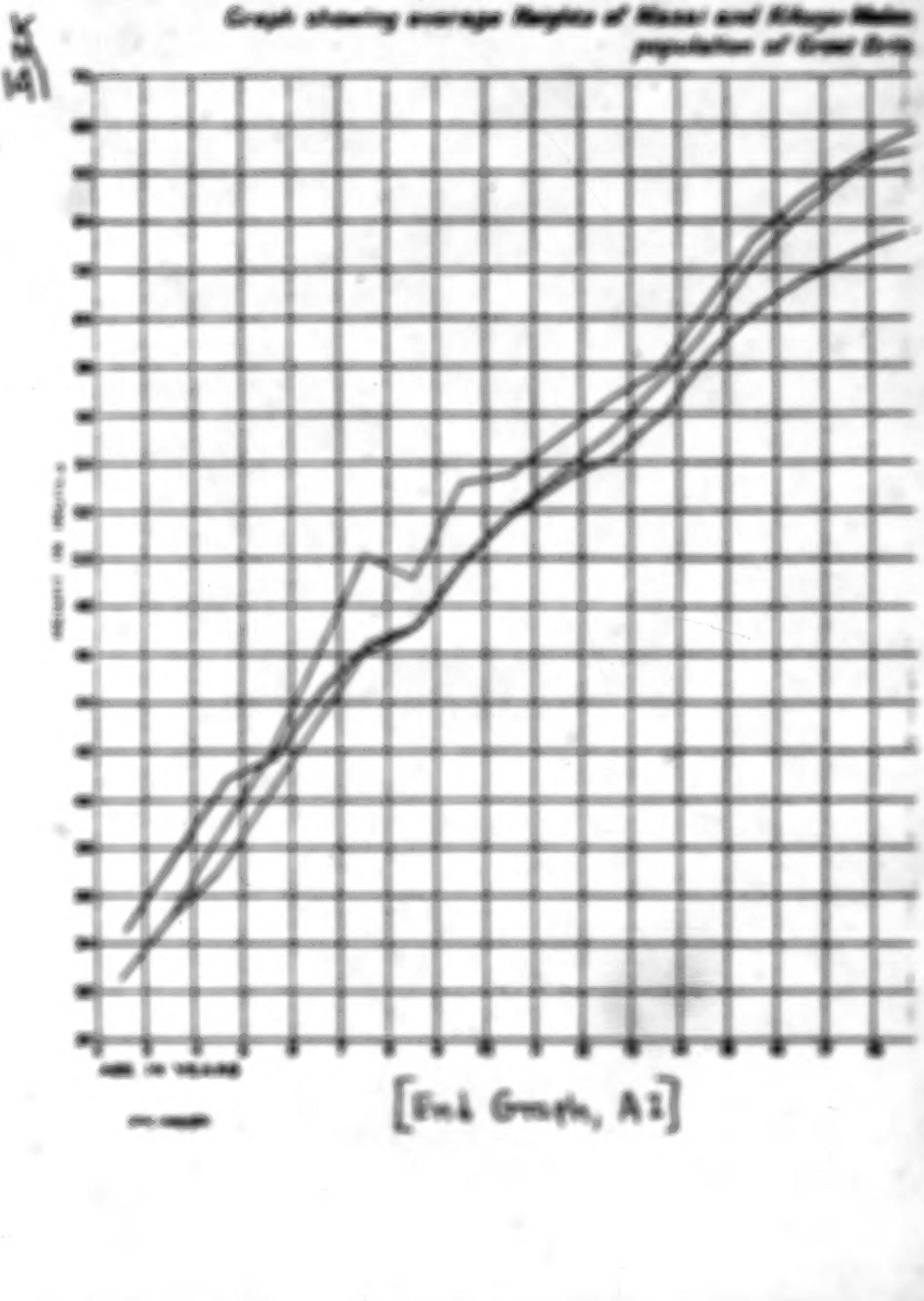
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
European Laboratory Workers.					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

14.Orr & Gilks D-4 (no date) 1931 Fl.12 Masai Fl.11
Kikuyu Fl.10

GRAPH I.

Graph showing average Heights of Masai and Kikuyu Males population of Great Brit.



[End Graph, A2]

16:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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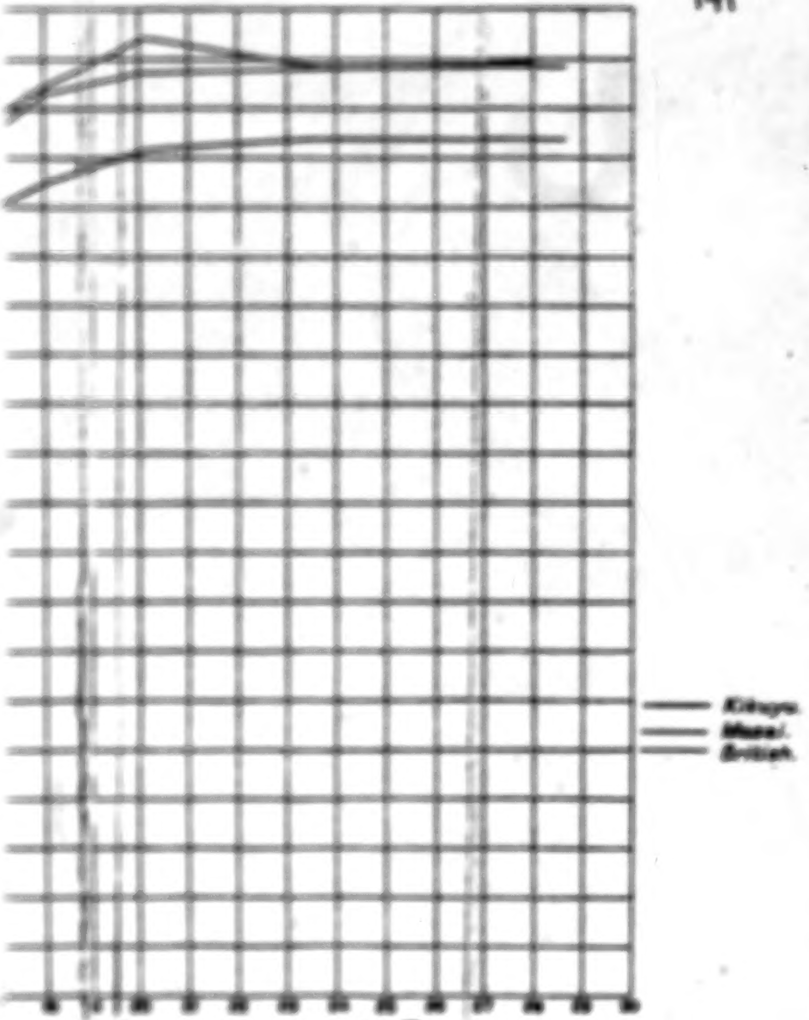
1.

[illegible] Masai compared with general Male of Britain.



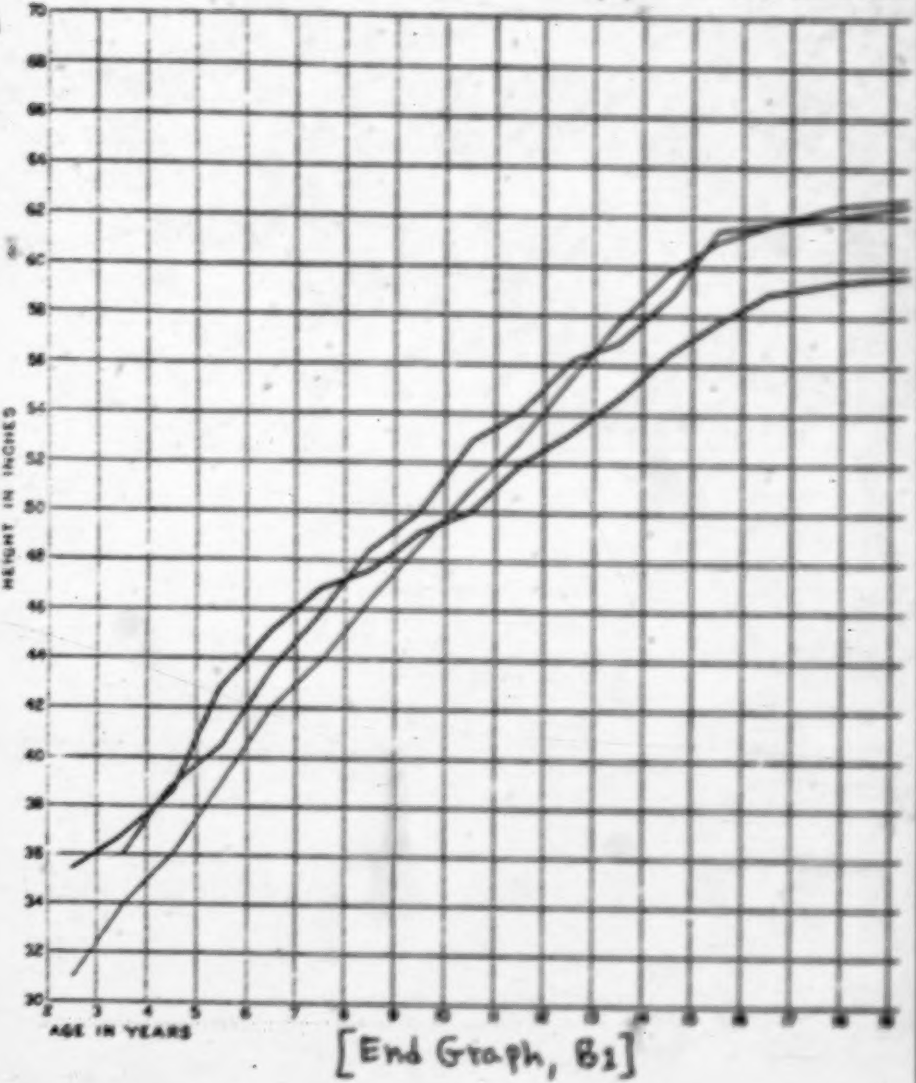
[End Graph, A2]

[illegible]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 2.

Graph showing average heights of Masai and Kikuyu female population of Great Britain



[End Graph, B1]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

H 2.

kuyu Females compared with general Female
reat Britain

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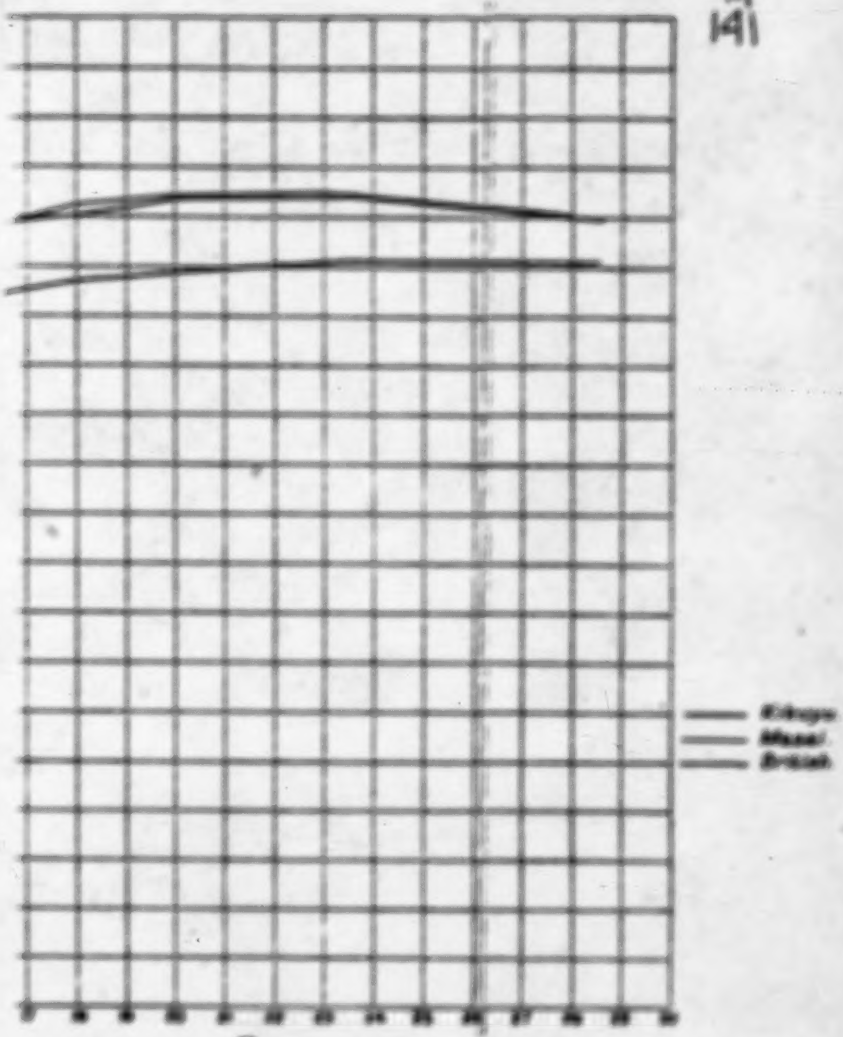
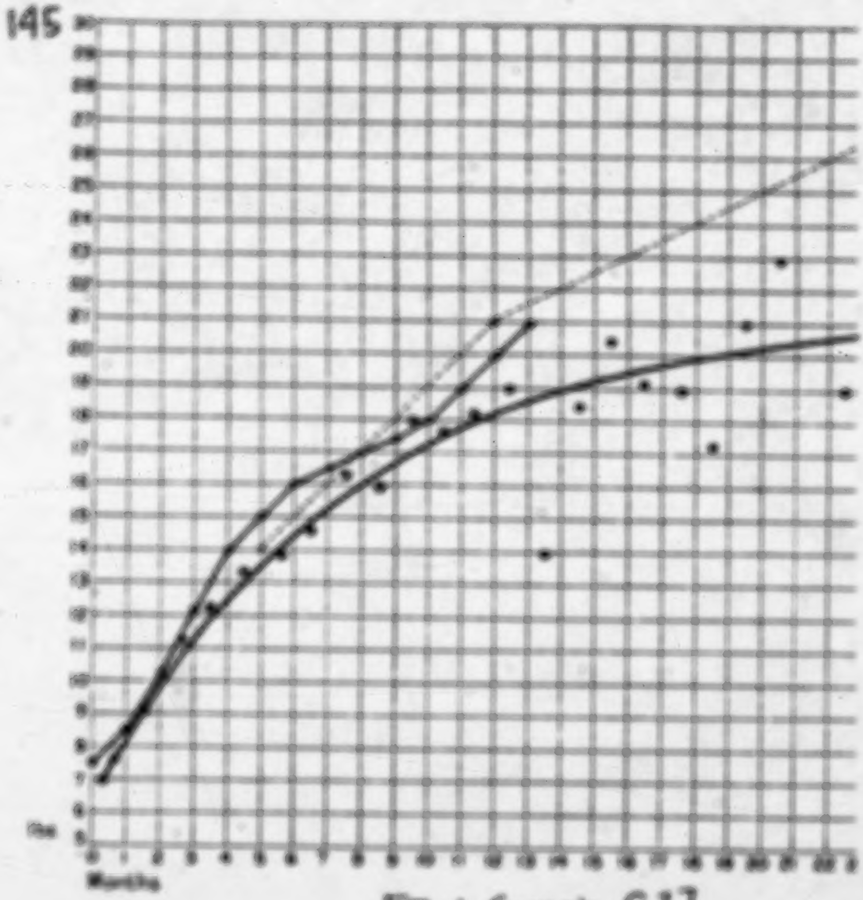


[End Graph, B2]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai
Kikuyu FL10

GRAPH 3.

Graph showing rate of growth of native (Kikuyu) in Kenya from birth to 30 months of age, comp of British and American children of similar age respective countries.



[End Graph, C1]

Weight of Kikuyu infants: Total number 58.

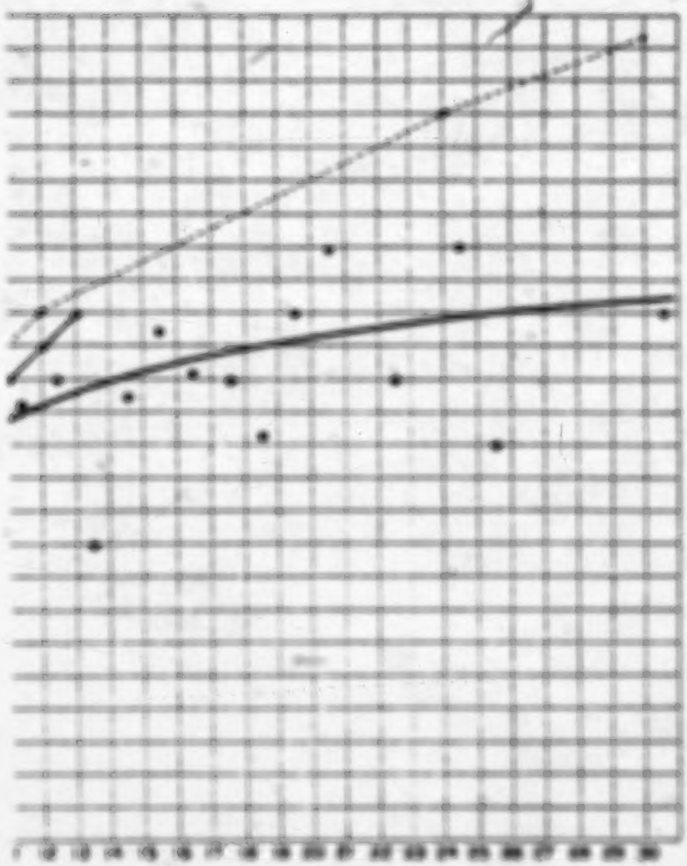
Weight of British

Weight of American

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai
Kikuyu FL10

GRAPH 3.

growth of native (Kikuyu) children
o 30 months of age, compared with that
n children of similar age in their



[End Graph, C2]

age infants: Total number 56. ———

do = ———

[illegible] = ·········

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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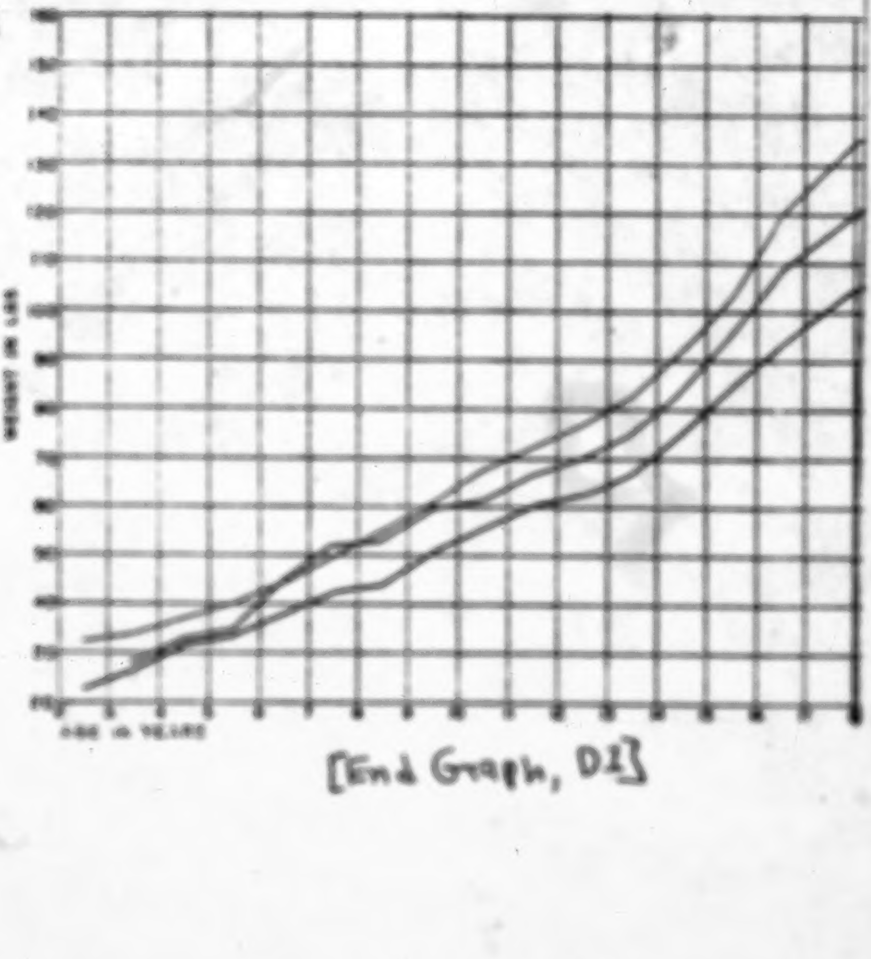
GRAPH 4.

Graph showing average weights of Kikuyu and Masai Ma
population of Great B



[End Graph, D2]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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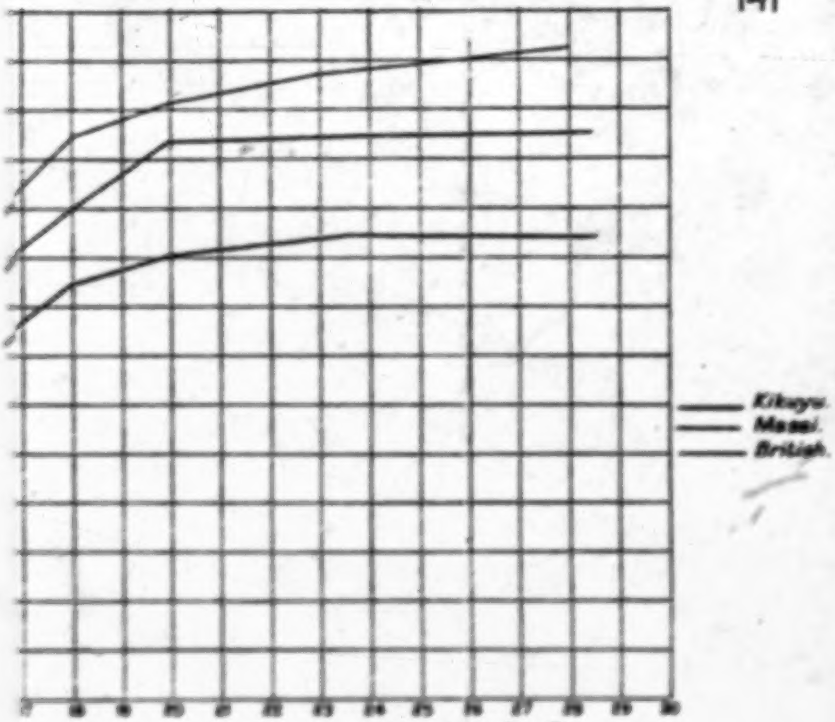
4.

sai Males compared with general Male
reat Britain.



[End Graph, D2]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 5.

Graph showing average weights of Kikuyu and Masai Fe
population of Great B

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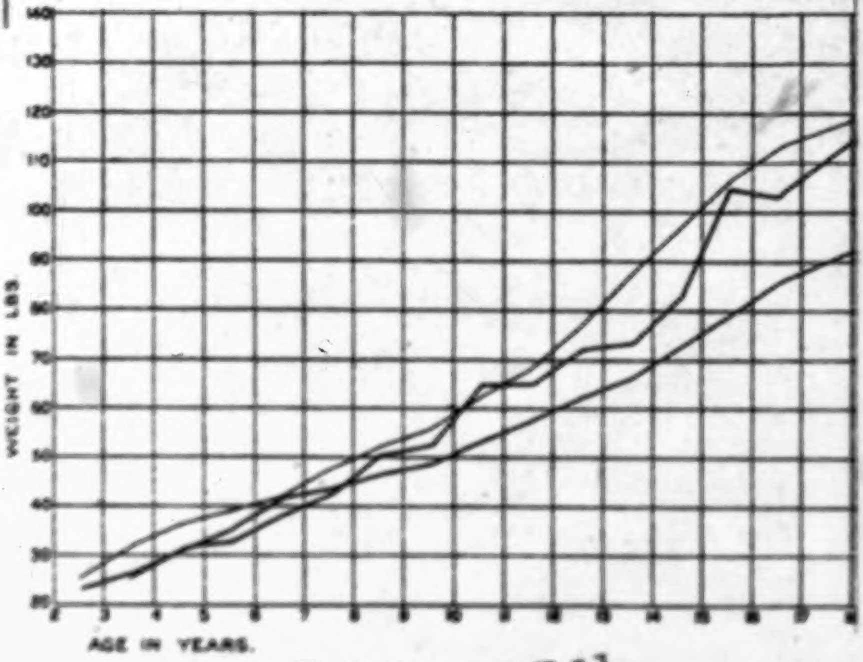

[End Graph; E 1]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

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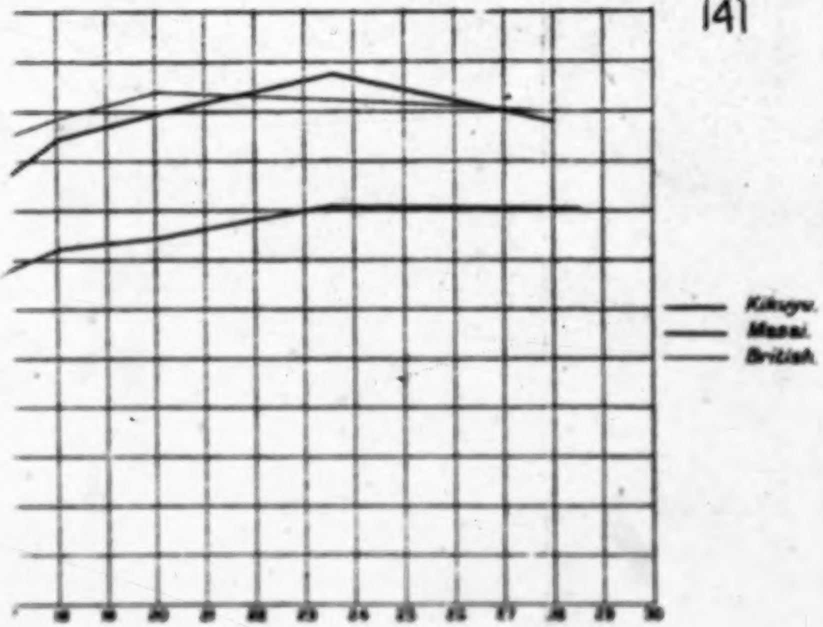
5.

i Females compared with general Female
eat Britain.

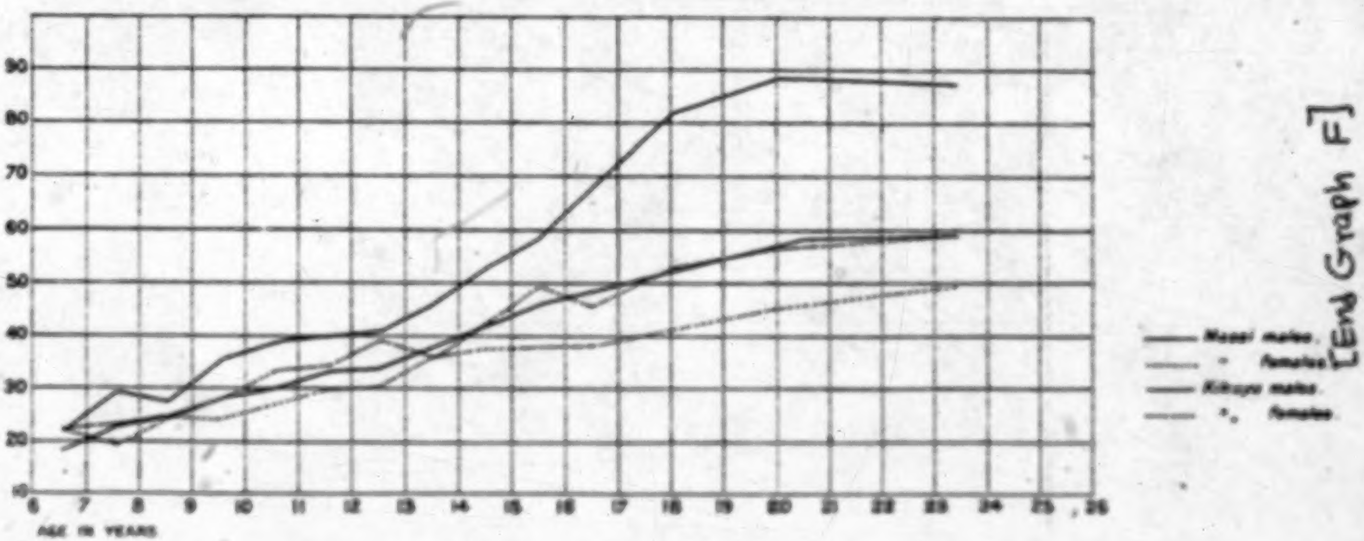


[End Graph, E2]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 6.

Graph comparing strengths of Masai and Kikuyu.



[End Graph F]

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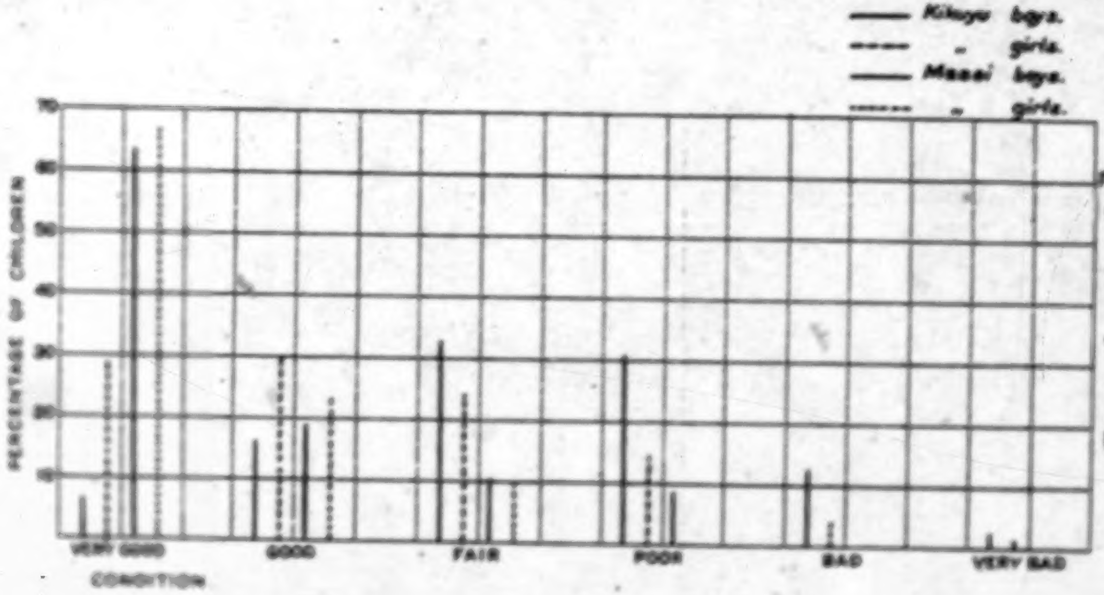
147

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 7.

Graph showing condition of Masai and Kikuyu children Ages up to and including 7 years.



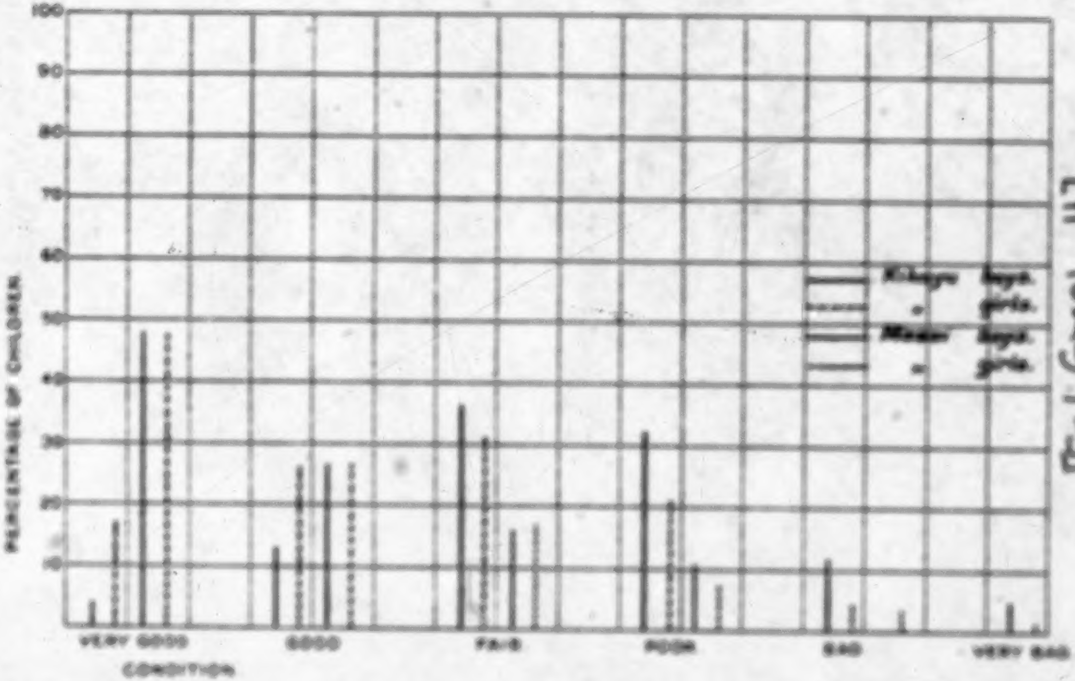
[End Graph G]

K M [illegible] [illegible]

14:Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 8.

Graph showing condition of Masai and Kikuyu children
Ages 8 to 11 years inclusive.

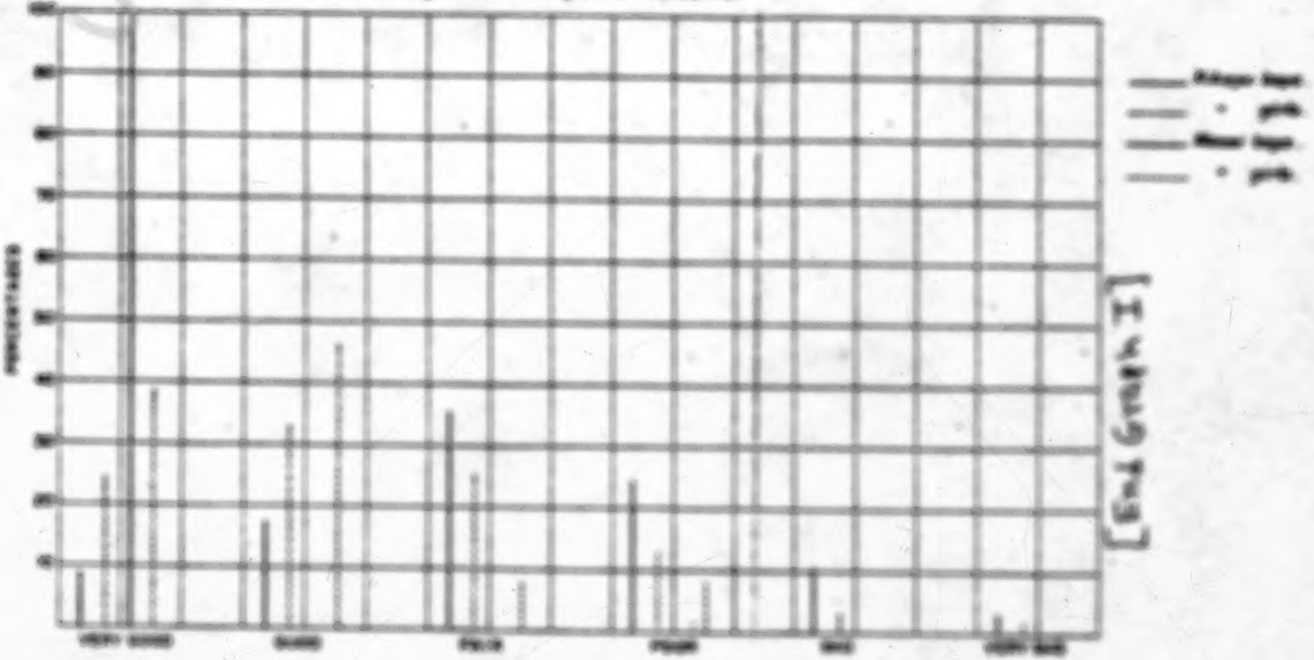


[End Graph H]

14-Orr & Gilks D-4 (no date) 1931 FL12 Masai FL12
Kikuyu FL10

GRAPH 9.

Graph showing condition of Masai and Kikuyu children ages 6 to 16 years inclusive.

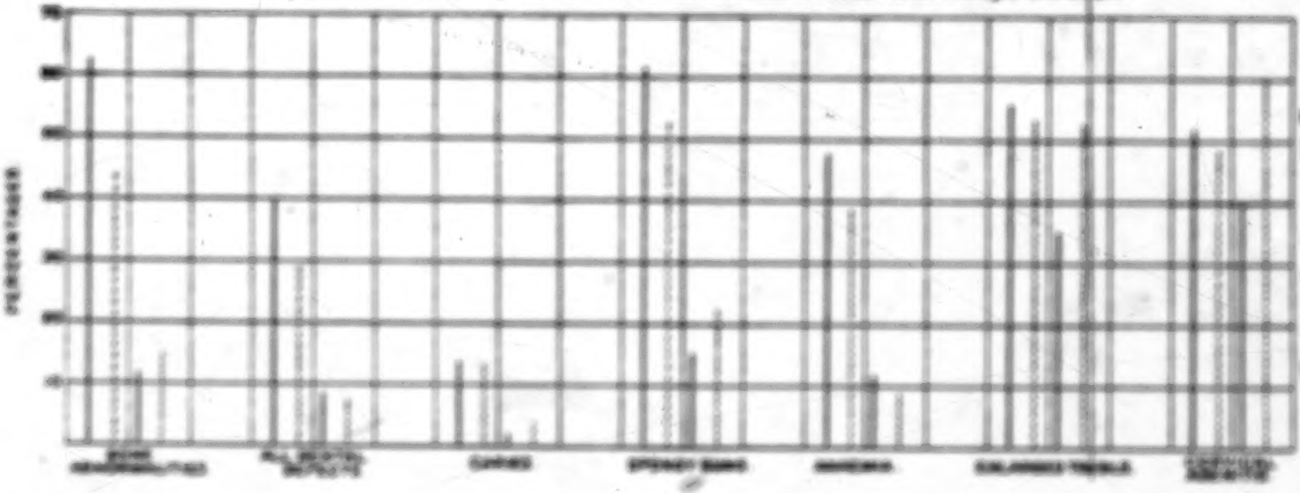


[End Graph I]

14.Orr & Gilks D.4 (no date) 1931 FL12 ^ Masai FL13, Kikuyu FL10

GRAPH 10.

Graph showing percentage incidence of diseases in Masai and Kikuyu children.



[End Graph J]

164A

GRAPH II.

Sugar Tolerance Test on Natives and Europeans
50g. Glucose